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LIEUT.-GENERAL LORD CHELMSFORD, G.C.B., &c., &c., in the Chair.

OUR INDIAN ARMY.

By General SIR ORFEUR CAVENAGH, K.C.S.I., &c., &c.

The CHAIRMAN: You will allow me to introduce to you Sir Orfeur Cavenagh. No doubt he is well known to many of those present, and to all by reputation. Sir Orfeur Cavenagh comes before you to give a lecture on a subject which must interest everyone, no matter whether he belongs to the Indian or to the British Service, and he comes with experience gained by long and faithful service in India, not only with the experience gained in peace time but also with the experience gained in war. Sir Orfeur served in the Gwalior campaign, and lost a leg at Maharajpoor; and also in the Sutlej campaign, where he was again severely wounded in the arm; so that he has practically seen what the Indian Army can do both in peace and in war time. I have no doubt that the suggestions that he will have to offer for consideration will be those that have been carefully thought out by one who has made the Indian Army since he left the country a subject of very careful study.

I HAVE had considerable hesitation in acceding to the request of the Council that I would read a paper upon the Indian Army, because but a short time has elapsed since I prepared a paper upon the same subject for the India Association. Many who were present at the discussion that then took place will doubtless be present this afternoon; whilst I am afraid I have no new ideas, no fresh suggestions to offer for their consideration.

All who are acquainted with the military history of our country, in which our Indian campaigns occupy so prominent a place, must equally be acquainted with the history of the rise and progress of the Indian Army, and the circumstances under which a force, originally consisting of a few native levies, gradually increased until it almost overshadowed the military power of the Crown, and numbered in its ranks nearly 300,000 disciplined troops. I will not, therefore, weary you by describing the several features that distinguished the Sepoys of the different Presidencies, or by giving you an account of the various changes that from time to time took place in the organization of regiments until the bulk of the native Army was placed upon a

uniform footing, each corps having a full complement of European Officers. There is, however, one point to which I would particularly advert, viz., the fact that from the commencement of the introduction of the regular system there were never less than eight European leaders to every native battalion, whilst the tendency was always to increase the number of European Officers to meet the various demands that were continually being made for their services. Unfortunately with the increase to their numbers there was a decrease of their power.

In the early days of our rule, an Officer commanding a battalion was vested with authority to chastise or reward; to use the Hindustani phrase, he was the father and the mother of his men, the authority to whom alone they looked for punishment or promotion; and there can be no doubt that in an army of Asiatics commanded by Officers who are aliens as regards race and creed, this is the wisest system that can be adopted. A spirit of insubordination rapidly spreads, and punishment should be therefore prompt and stern; equally there should be no delay in granting well-deserved preferment.

How far in those days Commanding Officers delegated any portion of their authority to their subordinates I have been unable to discover, but certainly, when I joined the Service, Officers did command their companies, and were held responsible for their due efficiency. One of the standing orders of the Bengal Infantry required every Officer in charge of a company to hold a private inspection parade once a week, transmitting a report of the result for the inspection of the Officer commanding the regiment. These inspections were real, not the mere formal inspections that subsequently took place (although in direct opposition to Army Regulations) at a regimental parade under the command of the Colonel.

The private inspection parade afforded the company Officer an opportunity—I may almost say the only one—of becoming acquainted with his men, and showing his interest in them, for when the parades were dismissed he generally entered into conversation with some of the seniors, who, if allowed, would gladly indulge in references to their past services, or, during any current campaign, to the news from the seat of war. I remember well an old native Officer who was only too delighted to give a history of the expedition to Egypt, whilst I frequently had letters submitted for my perusal from the relations of my men who were engaged in Afghanistan.

Under the old system a reciprocal good feeling existed between the European Officer and his native followers, a feeling no doubt enhanced by the *esprit de corps* that then prevailed amongst the native regiments and pervaded all ranks. Gradually, however, in this respect a great change took place, of which the causes and effects are described in the following extract from a paper submitted by me for the consideration of his Excellency the Governor-General shortly before the breaking out of the Mutiny.

"As mercenaries the Sepoys have hitherto been bound to the British Government by two great ties, the first and most powerful being that of regularity in the issue of their pay, and the grant of pensions to themselves when incapacitated for the performance of further duty

and to their families in the event of their being killed in action or dying from disease whilst on foreign service.

"The second, although perhaps not equally strong, yet still of considerable importance, being the bond of individual attachment to their European Officers.

"The first, notwithstanding that it must still necessarily have great weight amongst the men of the native Army, has certainly been considerably weakened since the introduction of the present system of awarding comparatively speaking high salaries to Suddur Ameens, Moonsiffs, &c. Until lately the native Officer was one of the best paid functionaries under the British rule: he was consequently respected accordingly, and held amongst his fellow-countrymen a position far superior to that enjoyed by any other servant of the State. In this respect, however, a great change has recently taken place, and he now finds himself, both as regards allowances whilst serving and pension on retirement, in a pecuniary point of view, infinitely worse off than the native uncovenanted Officer, in all probability a Bengali, and thus one of a race which the Hindustani of the North-West is accustomed most thoroughly to despise. No doubt his own status has also of late years been much improved by the grant of full pay after forty years' service, and by the institution of the Orders of Merit and of British India. Still it has not been advanced in the same ratio as that of the members of the uncovenanted service, and there can be little question that amongst themselves a comparison is often drawn by native Officers between their position and that of the Moonsiff or Suddur Ameen at the station where their corps may happen to be located; a comparison that, in former days, would have been all in their favour, but is now the reverse. In this respect, the Officers of the irregular cavalry are on a much better footing than their comrades of the line, hence in that branch of the Service, notwithstanding that the troopers are decidedly underpaid, mutinies are, I may say, almost unknown, and, though there may be many other causes combining to lead to this result, I feel tolerably convinced that the respectable rates of pay granted to Ressaldars and Resaidars tend greatly to maintain the spirit of subordination that has always been evinced by the men of this arm.

"The second tie has been still more weakened than the first, in fact, it may be said to have been almost entirely severed. There may be still a few cases where the Sepoy would willingly risk his life to save that of his Officer, but these are the exceptions; the reverse is the rule. Many causes have led to this, and unquestionably the Government is not entirely blameless in the matter. For years past every fresh order has tended to confirm a system of centralization, under which the European Officer has become a mere cypher at the head of his regiment or company. He ceases to take an interest in his men, and is satisfied with receiving the usual daily reports and performing his duties with a listless indifferent spirit, not calculated to inspire with affection or respect those under his orders, who are keen observers of character, and who, on their part, cease to look upon him as their natural friend and protector, and only approach him when compelled

to do so in the execution of any prescribed duty. The system of centralization is not, however, the sole origin of this very unsatisfactory state of affairs. Another great cause has been the recent large additions made to the list of Officers on Staff employ. An Officer no longer looks upon his regiment as his home. If he has ambition and talent he naturally turns his thoughts towards the field where that ambition may be gratified and that talent obtain scope for development. In time of peace that field is certainly not to be found with his corps. Is it, then, to be wondered at that he should seek for wealth and distinction either in the ranks of an irregular corps, where, whilst still a young man, he may rise to command with all its concomitant advantages, or that, if endowed with a less soldierly spirit, he should wish to enter one of the civil commissions open to the military Officer, and acquire, as an administrator, that fame he is unlikely ever to obtain in his own profession? Now, it cannot be denied that the fact of there being so wide a field in India in which Officers may have an opportunity of exhibiting their various talents has tended to improve the tone of the Service, and to instil into the minds of those who enter it a spirit of emulation which should exist in the heart of every soldier, but this spirit may be carried to too great an extent, and when it has so far passed its legitimate bounds as to render regimental duty wearying and irksome, it should at once be curbed and restricted to its proper limits. This is the case at present; it is therefore necessary that proceedings should be adopted towards remedying an evil likely, in its results, seriously to impair the efficiency of our native Army, and thus probably lead to the material diminution, if not eventually to the total subversion, of our supremacy in the East. On this subject I need not expatiate; unfortunately the evil is too glaring."

I suggested several changes towards remedying the evils upon which I had animadverted, amongst them the extension of the powers of regimental courts-martial, the grant of increased authority to Officers commanding regiments and companies, the formation at central stations, in the neighbourhood of the Sepoys' homes, of reserve battalions, to afford the necessary opening for native Officers, the appointment of a native Adjutant to every regiment, the introduction of a system of examination for native commissioned and non-commissioned officers, and of more stringent rules relative to the employment of European Officers upon the Staff.

The breaking out of the Mutiny, an event I had for some time anticipated, prevented the question as to the necessity for reform in the native Army being taken into consideration, and, when the storm blew over, that Army, as far as Bengal was concerned, had in a great measure ceased to exist, and the Government had almost a *tabula rasa* upon which to operate. The levies raised during the war upon the irregular system had done good service, whilst even previously the general excellent behaviour of irregular troops had been advanced by some enthusiasts as an argument for placing the whole Army upon the irregular footing, the able men by whom this argument had been used having totally ignored the fact that, as a body, native Officers of irre-

gular cavalry, the branch that had been most distinguished, were of a better class, and, owing to the numerous augmentations that had been made to the irregular service, as a rule much younger, than their compeers of the line. The European Officers also were all necessarily young, for upon an Officer attaining the rank of Major he usually rejoined his line regiment, and, although it would have been unjust to their comrades to say that the irregular Officers were the *élite* of the Army, yet, as a rule, they were all selected for their knowledge of the native languages and general military qualifications.

The irregular cavalry offered a suitable field for the employment of the native gentry, who were willing to accept military service. Hence, as already remarked, the native Officers were often superior men, quite competent, under the supervision of a few selected European Officers, to perform all the ordinary duties connected with the command of their troops and squadrons. These troops, however, rarely acted in large bodies, and their most gallant feats were achieved by small parties under distinguished European leaders. Indeed, owing to their being admirably adapted for the performance of all the harassing duties that devolve upon light cavalry in the field when employed with a large army, they were never spared, and a regiment was so cut up by being called upon to furnish innumerable guards and escorts that often there would be scarcely 100 men present at headquarters, and with these there would be three European Officers, a larger proportion than with the same number of regular troops.

The new levies were composed of men taken from the finest races in the East, the Sikhs and Goorkhas, yet during the Mutiny and the campaign in China it was considered advisable to attach a large body of European Officers to each of the regiments actively employed, and this alone saved them from becoming inefficient. In one corps alone nine or ten Officers were killed or wounded in the course of a few months. During the operations in Bhootan, regiments became notoriously unfit for service, owing to the Officers having been rendered *hors de combat* by sickness, whilst in the Umbeylah campaign the irregular system equally broke down, and Officers had to be despatched at a great expense from all parts of India, to fill up the vacancies caused by casualties in the European commissioned ranks. Had the campaign in Abyssinia been prolonged, or strenuous resistance been offered to our troops, the same result would have ensued.

Many Officers who had given the matter due consideration were opposed to any radical change in the organization of a native regiment; but there was a bait that could be offered by the advocates of the irregular system that could not be resisted. This tempting bait was the supposed saving to be effected in the reduction of the cost of the European element. Whenever you wish to induce John Bull to sanction some unwise reform, you have only to raise the cry of "Economy." He is far too apt to forget that true economy can only be based upon efficiency, and that when that fact is forgotten, in the hour of trial there is often a needless sacrifice, both of lives and money, to rectify defects which ought never to have existed.

There can be no doubt that previous to the Mutiny, consequent on

the great extension of the irregular force, the native element in our Indian Army had increased beyond its due proportion, and that subsequently, owing to the augmentation of the British contingent, the necessity for a large number of native troops of the line had ceased.

Had the Government then reduced the number of infantry troops of the line by one-half, at the same time offering liberal inducements to Officers to retire, and absorbing one step in three, there can be little doubt that by this time the number of Officers would have been but little in excess of that required for 78 regiments, viz. (allowing for each regiment an establishment of 24 Officers, to admit of a fair proportion being employed upon the Staff or with irregular troops), 1,872, of which, as shown below, but few would have been in the higher grades.

Lieutenant-Colonels	78
Majors	78
Captains	624
Lieutenants	1,092
Total	1,872

As, however, already pointed out, the cry of "Economy" was too powerful to be opposed, and all native corps were therefore directed to be organized on the irregular system. In the first instance, five Officers, a Commandant, two Wing Commanders, an Adjutant, and a Quartermaster were sanctioned for each regiment; subsequently two more Officers, now styled Wing Officers, were added.

The result is shown below.

Return of Officers borne on the Lists of the Indian Staff Corps.

	1876.	1878.	1879.	1882.
Lieutenant-Colonels	650	620	607	518
Majors	400	491	582	454
Captains	650	475	349	323
Lieutenants	220	215	345	540
Total	1,920	1,801	1,883	1,835

This return does not include 143 Lieutenant-Colonels, 217 Majors, and 14 Captains of Her Majesty's Indian forces. As it must be remembered that for several years past bonuses and increased pensions have been granted to Officers for the purpose of facilitating retirements, and that the burthen upon the pension list must be now very heavy, I am afraid that, in a financial point of view, the framers of the new scheme can hardly be congratulated on their success. This array of field Officers must often give the Finance Member of Council a *mauvais quart d'heure* when he prepares his Budget Estimates.

Having examined the question in its financial point of view, I will now proceed to study it in its military and political aspects.

There is an old saying that in a well-regulated household there should be "a place for everything, and everything in its place." Now this saying is certainly applicable to a well-ordered regiment; hence it was to be supposed that under the new formation the duties of every Officer, whether on or off parade, would have been distinctly defined. I cannot, however, discover that, up to the present, anything definite has been determined as to the duties to be performed by a wing Officer. He is certainly to be mounted on an inexpensive charger, but that does not convey to the mind any exact idea as to the duties he is to perform when astride on his gallant steed; again, it is stated that he is generally to assist his Wing Commander, but the notion of the assistance to be rendered seems of a vague and indeterminate character. Is he to exercise command over, and be responsible for, the movement of his companies, or is he simply to follow at the heels of his commander, to act as his mouthpiece and repeat his orders? This is a point that should not be allowed to remain unsettled, yet I am not aware of the issue of any edition of the "Field Exercise Manual" prescribing the positions and duties on parade of seven (now eight) mounted Officers with an infantry battalion. One Colonel of my acquaintance, who was a very smart Officer, never allowed more than three of his Officers to appear at the same time on parade, as he stated the others were only in his way.

There can be little doubt that in actual warfare the wing Officer would often dismount and place himself at the head of any portion of his wing that might require leading, but is that system a wise one which entails upon an Officer the necessity for exercising, for the first time under heavy fire, a command the duties of which he has never practised on parade? With the present loose formation for attack it is more essential than ever that the men should have confidence in their Officer and be accustomed to his mode of command; mistakes might be committed in the presence of an undisciplined though gallant enemy, such as we have recently engaged in Afghanistan, which would prove fatal before a better disciplined foe.

If the Indian Army is to prove a source of strength instead of weakness to the Empire, it must be prepared to meet the best troops of civilized Europe, for the struggle to check the invasion of Hindostan may take place in Egypt or in Asia Minor.

I have already pointed out that one of the evils that arose under the old system was the gradual weakening of the bond that previously existed between the European Officer and the Sepoy, this evil, apparently, the introduction of the new organization has served to intensify. Many Officers join the Indian Army solely with the view of obtaining Staff employ; even if an Officer has made up his mind to continue in the performance of regimental duty he has no special tie to connect him with any particular regiment; if he is a wing Officer he naturally strives to secure promotion to the post of Adjutant or Quartermaster, and, if an Adjutant or Quartermaster, to that of Wing Commander. If, therefore, he has interest at headquarters, it is quite possible that in the course of a few years he may be attached to five or six different corps; hence, instead of attaching himself to his

regiment, taking an interest in its institutions and a pride in its good character, he naturally thinks mainly of his own advancement.

I was much struck once by a remark made to me by an old native Officer that, under the present system, with the exception of the Colonel and the Adjutant, who had to maintain their own reputations, no Officer took an interest in his regiment and every one would be quite prepared to join another corps to suit his own convenience. On a former occasion a very gallant friend of mine objected to the old organization on the ground that the Officers gave too much support to their men. I am of opinion that an Officer must stick up for his men if he expects his men to stick to him. I was once posting a picquet when the Brigade-Major, unwittingly I am sure, owing to ignorance of the language, addressed a native Officer in abusive terms. I immediately called him to account, and that distinguished Officer, Brigadier Cureton, who was present, held that I was right.

One of the great arguments that has been advanced in favour of the present system is that it affords greater power of selection. Now, although opposed to the opinion of doctrinaire writers, I am convinced that practical soldiers will agree with me in thinking that, except as regards the highest posts, promotion by selection is neither just to individuals nor advantageous to the State; for, with every desire to act fairly on the part of those high in authority, it must often to a great extent degenerate into promotion by favouritism. There is, I am sure, not one here who, in the course of his career, has not known quiet, steady Officers in whom, in case of emergency, their comrades, both Officers and men, would have had perfect confidence, yet devoid of those showy qualities likely to attract notice and lead to their promotion. The Officer who shines in the study and class-room is not necessarily the best in the field, where sound judgment, fertility of resource, and perfect self-command in the hour of difficulty and danger, qualifications that cannot be tested by examinations, are of more importance even than scientific attainments. The two greatest disasters that have of late years befallen the British arms, Maiwand and Majuba Hill, occurred under the command of specially selected Officers, one of whom bore the highest reputation; whilst that brilliant achievement, the defence of Rorke's Drift, was accomplished under the guidance of an unknown subaltern.

If an Officer is unfortunate in his regimental promotion, although he may feel sore at finding himself superseded by his contemporaries in other corps, he knows that he has no just cause for complaint; moreover, he often solaces himself with the hope that, on the theory of averages, he may yet reach his proper level by obtaining more rapid advancement in the higher ranks; but when he is superseded by a transfer from another regiment, he is deprived of that hope, and frequently attributes his supersession to his want of interest, hence a spirit of discontent is engendered which must be extremely prejudicial to the interests of the Service.

That an inefficient Officer, and inefficiency is easily discovered, should be passed over as disqualified for the exercise of the duties of high command cannot be denied, but such disqualification, of which due

intimation should be given, is very different from promotion by selection.

It may be said that under the existing organization our native troops have behaved well during the recent campaign in Afghanistan, and that the want of Officers has not been felt; but it must be remembered that throughout the campaign our troops have never been exposed to a heavy cannonade or suffered as on the Sutlej and in the Punjaub a loss, as shown in the margin,[1] of five and six Officers per regiment in a single action. Had only half that number been rendered *hors de combat* the results might have been most disastrous. Moreover, without in any way detracting from the skill of the Generals or the bravery of the men, it may, I think, be fairly asserted that no episode of the last war, however brilliant, can, as a military feat, be compared with the defence of Jellalabad and subsequent defeat of Akbar Khan by the illustrious garrison; the defence of Candahar and advance to Caubul under Nott; the defence of Kahun, or even the defeat of the Ghilzais by the 38th Regiment B.N.I. under Wymer, when the corps was surrounded, and yet by the steadiness of its fire completely discomfited its assailants. In those days our troops were all Hindustanis and armed with a weapon inferior to that possessed by their enemy, hence they triumphed solely by their discipline; recently the superiority of weapon has been on our side, whilst many of the troops engaged were composed of the best fighting material to be found in the East.

The only advantage that has accrued under the new system has been the increase of authority granted to Commanding Officers, but as that might have been accorded without involving any change in the organization of regiments, even from the mere military standpoint, it can hardly be regarded as a success.

I will now proceed to consider the question from its political point of view, as mentioned in the paper submitted for the perusal of the Governor-General in 1857. Native Officers had for some time previous regarded with disfavour the improvement that had taken place in the status of the Government civil employés, and contrasted, with a grudging spirit, their comparatively high rate of salaries with the pay they themselves received. Since then, whilst greater opportunities for rising have been afforded to the native civil servants who are now eligible to succeed to the high office of Judge of the Supreme Court, but little change has been made in the general position of the native Officers; and, although one or two exceptional promotions have been made, as a rule the

[1] *Return of Officers killed and wounded.*

Sutlej Campaign.—2nd Regiment, 2 killed, 4 wounded; 16th Regiment, 1 killed, 3 wounded; 42nd Regiment, 2 killed, 5 wounded; 48th Regiment, 6 wounded.

Ferozeshuhur.—26th Regiment, 2 killed, 2 wounded; 12th Regiment, 4 wounded; 14th Regiment, 5 wounded.

Sobraon.—41st Regiment, 1 killed, 7 wounded.

Chillianwalla.—30th Regiment, 2 killed, 9 wounded; 36th Regiment, 1 killed, 5 wounded; 45th Regiment, 4 wounded; 56th Regiment, 3 killed, 5 wounded.

highest rank to which they can hope to attain is that of Ressaldar or Subahdar. To make matters worse it has been suggested that native gentlemen should be allowed to enter the Army as Officers, that is, you are to place an educated man, whilst still in his youth, in a position where he may acquire great influence over his fellow-soldiers, and at the same time hold out to him no hope of ever rising. Human nature is the same in Asia as in Europe, and you cannot expect intelligent men to commence their military career as Officers and then remain all their lives in the lower grades without feeling extremely discontented. Native gentlemen did not consider it derogatory to their rank to enter corps of irregular cavalry as troopers (I had an orderly whose uncle was Nawab of Jujjhur), and although their promotion was often rapid, yet they had to pass through every grade before they became Officers; hence, for a considerable portion of their period of service they had some advancement to look forward to. Any change in this respect is greatly to be deprecated; at the same time, however, some additional openings must be provided, some further incentives than heretofore to induce the sons of the small native landed gentry and yeomanry, who are thorough soldiers at heart, to enter the Army. They must be able to calculate upon attaining commissions as Captains and Lieutenants, with a prospect of succeeding to higher rank as a reward for distinguished service in the field; but where are those openings to be found? They do not exist under present arrangements. Regiments are neither regulars nor irregulars. If it is intended that European Officers should merely exercise general supervision, and natives command troops or companies, of the former there are too many; if, on the contrary, they are to become in action the actual leaders of their men, there are too few.

It must be acknowledged that the native military servants of the Crown cannot much longer be debarred from rising to higher rank than that to which they now ordinarily attain, but to increase the stability of our Indian Empire, and avoid running the risk of imperilling our military supremacy, it is imperative that the majority of the leaders of our native troops should be European.

In the Army as now organized, whilst we have in a great measure abolished *esprit de corps*, and thus seriously impaired the bond between the European Officer and the Sepoy, we have increased the influence of the native Officer, though we still rigidly check the indulgence of any hope of succeeding to higher rank and pay, which must be the natural result of such influence; thus we are training in military knowledge and to habits of command a large body of natives for the gratification of whose legitimate ambition we offer no suitable field.

Is this just to men who may at any time be exposed to great temptations, and their allegiance assailed and shaken? That it is politic no one would, I think, presume to argue.

I have now reviewed the prevailing organization of the Indian Army in its financial, military, and political relations, and, I am afraid, in neither one of these respects can it be deemed worthy of praise.

It is, however, very easy to point out defects and to condemn them, but not, perhaps, equally easy to suggest an appropriate remedy.

In determining the organization of an army, it is essential in the first instance to consider the nature and extent of the duties it is called upon to perform.

When an army is required to protect an open and extended frontier exposed to attacks from an immediate and powerful neighbour, so that in the event of war the whole military strength of the country may be at once needed to repel the threatened invasion, then it may be wise, as a financial necessity, in time of peace, to retain the cadres of regiments on a reduced footing so as to admit of their being rapidly augmented on the outbreak of hostilities; if, on the contrary, a State from the nature of its frontier is free from the risk of invasion except by a comparatively speaking limited force, whilst its Army may be constantly engaged in what may be styled minor wars, either within or without its boundaries, then it tends both to efficiency and economy to keep its fighting line always at its full strength, but with suitable reserves to take its place for the preservation of the peace of the country when its services are otherwise needed. In the one case the mobilization of the whole Army is a gigantic task, requiring much previous thought and labour, whilst the slightest friction may neutralize all the ability and energy of the military authorities; in the other the task is an easy one, the regiments composing the first line, being always in a state of readiness for active service, can at once be placed in motion, whilst the mobilization of the Reserve takes place in the stations they have vacated; hence, there is no delay in throwing a small but thoroughly efficient force upon the theatre of war, and thus an insurrection may be crushed or the fate of a campaign decided which otherwise might be protracted for months or years, and lead to an infinite expenditure both of life and treasure.

India may certainly be classed under the second category: almost surrounded by the sea, an attack in force by a disciplined foe is only to be anticipated from the north-west. It is, therefore, in that direction that our attention should be mainly turned. At present it would be difficult to calculate with any degree of confidence on the circumstances under which the campaign might open, the probable strength of the invader, the opposition he might experience from the people of the country he would have to traverse, or the support that they might be willing to accord to ourselves. These must depend upon political changes which are still in the womb of time, regarding which, therefore, we can only indulge in speculation, and it would be unwise to express any very decided opinion. The ablest military writers are, however, in accord on one point, that in the event of a struggle for supremacy in the East, it would be necessary to prevent an enemy from seizing upon the important position of Candahar, hence assuming that, both in a military and political point of view, it would be advisable to advance to the neighbourhood of that city, it is not unreasonable to suppose that we ought always to be prepared to place a force of 50,000 men in the Turnak Valley; here, should success attend our arms, it would in all probability prove decisive, whilst if

we met with a reverse we should retire upon our reinforcements, and be again in a position to arrest the enemy's progress, whilst in the meanwhile peace and quietness would prevail throughout our own dominions.

I have already remarked that an attempt to threaten our position by an advance on Herat might, perhaps, be checked in its outset by a counter-attack in which India might be required to take a part; but, in such an event, probably a force of 50,000 men would equally be the utmost strength of the contingent she would be called upon to furnish. Although in the case of complications arising with either of the native States on our eastern frontier, in order to prevent a prolonged contest it would be requisite to employ a respectable force in the first instance, and not carry on the war by driblets, yet to evince our superiority over either Power, an army of 50,000 would scarcely be needed; thus we have a basis on which to calculate the numerical strength of the force which should be maintained in readiness to meet any extraordinary emergency, and I will, therefore, now proceed to consider the details of the military establishment that would admit of such a force being always available for active service, without, at the same time, too heavy a burthen being flung upon the finances of the country; of course, of that force a certain proportion, perhaps one-third, would be European troops, to which my paper does not refer, but, as it must be remembered, that to place 50,000 men in fighting line, at a distance from our frontier, allowance must be made for numerous detachments employed on escort duty along the line of communication, the native portion might possibly be fairly estimated at 44,000, viz., 12 regiments of cavalry of 720, and 39 regiments of infantry of 900 each (exclusive of European Officers).

In accordance with the changes recently authorized in the native Army, its present strength may be computed at 114,000, viz., 31 regiments of cavalry, 17,000; and 113 battalions of infantry, 97,000. I would increase that strength to 124,000, divided into 27 regiments of cavalry and 117 battalions of infantry; of the former 24 regiments and of the latter 78 battalions being always kept complete, the remainder forming a reserve. This arrangement would provide in time of peace a garrison of about 105,000, to be disposed as follows:—

Lower Bengal and Assam	6,000
Central Bengal and Oudh	10,000
North-West Provinces and Rohilkund....	10,000
Central India and Gwalior	10,000
Punjaub and North-West Frontier	30,000
Bombay and Sinde	15,000
Madras and Hyderabad	20,000
Burmah	4,000
	105,000

On the active list, every regiment of cavalry should consist of four squadrons, with the usual complement of native commissioned and non-commissioned Officers, and the following European Officers:—

1 Lieutenant-Colonel,
1 Major,
4 Captains,
2 Lieutenants.

The Captains to command squadrons and the Lieutenants to perform the duties of Adjutant and Interpreter and Quartermaster.

Every regiment of infantry should consist of eight companies, with one native Officer per company, and the usual complement of non-commissioned officers, and the following establishment of European Officers:—

1 Lieutenant-Colonel,
1 Major,
8 Captains,
10 Lieutenants.

The cavalry should be divided into three groups of eight regiments, to each group a reserve regiment being affiliated, whilst every two regiments of infantry should have a reserve battalion attached. The European staff for reserve regiments and battalions would be a Commandant, with an Adjutant for cavalry, and an additional Officer as Quartermaster, for infantry, all selected from their corresponding corps on the active list; the establishment of native commissioned and non-commissioned officers should be complete, but only one-half of the troopers or Sepoys should be permanently embodied, in case of emergency the ranks being filled up by men from the reserves, liable to be called upon to serve in the event of war, but ordinarily only required to attend annually for one month's training, during the rest of the year residing at their homes and receiving a small sum as reserve pay. Reserve regiments and battalions should be permanently located at central stations in the vicinity of the districts from which their affiliated regiments, to which they should act as depôts, generally obtain their recruits. Every soldier having served three years with the colours, if of good character, should be permitted to join the reserve, whilst the men to be permanently embodied in reserve regiments and battalions should all be taken from corps on the active list, which would give Commanding Officers an opportunity of keeping their regiments thoroughly efficient by weeding out men who, although perfectly fit for garrison duty, might possibly soon succumb if exposed to the hardships of a campaign.

There should be but one Indian Army under one Commander-in-Chief; a certain proportion of the 78 active battalions of infantry should, however, always be recruited from each Presidency, within the limits of which, although available for general service, they should be ordinarily stationed. As regards the European Officers there should be no distinction, and they should be eligible to succeed to divisional or brigade commands, or to Staff appointments in any part of India, without reference to the Presidency in which they may be serving.

All Officers now in the Staff Corps would, of course, retain their

present rights and privileges, but for the purpose of regulating promotion, their names should be placed in the cadres of the new regiments, the existing 156 cadres being reduced to 78, by the process of doubling up the 1st and 38th Bengal, the 1st and 27th Madras, and 1st and 16th Bombay, and so on throughout the whole number.

Young Officers, after obtaining their commissions at Sandhurst, should all be posted to infantry regiments according to vacancies, but, after having performed two years' regimental duty, and passed the prescribed examinations, an Officer should be eligible for transfer, on probation, to a cavalry corps as Interpreter and Quartermaster; at the expiration of a year, if recommended by his Commanding Officer, he might be permanently appointed to that branch of the Service, and his name removed from the rolls of his previous regiment.

As at present, Officers should be employed upon the Staff, but appointments should only be for five years, and the number of absentees on this account from any one corps should be strictly limited. In the event of its being the desire of Government to retain the services of an Officer in either of the military departments or civil commissions for a longer period than five years, he should be seconded, whilst after ten years he should either rejoin his regiment or be removed to a Staff Corps. This arrangement would prevent the evil of which regimental Officers under the old *régime* justly complained, that the sweets of Staff employ, by inducing Officers to remain in the Service, acted as a bar to promotion; at the same time it would be advantageous to the State, as it would enable trained men, without sacrificing their military prospects, to remain in departments for which they might prove themselves peculiarly fitted.

I will now revert to the native Officers. I have suggested that with the active infantry battalions there should be only 8 native Officers, 4 Subahdars and 4 Jemadars; with a proper establishment of European leaders, more are not needed, but with the reserve battalions there should be two native Officers to every company, and in these battalions and in the reserve cavalry regiments would be afforded the opportunity of improving their positions by conferring upon a certain number commissions as Captains and Lieutenants; this would prove a great incentive to men of respectable families to enter the Service, and, at the same time, allay the feeling of discontent amongst the soldiery, occasioned by the great change that has, as already remarked, of late years taken place in regard to the relative positions of native military and civil servants, more especially if a prospect were held out of attaining to even higher rank as a reward for good service or for gallantry in the field; it might, indeed, be a question whether ultimately some of the reserve regiments and battalions might not be placed under the command of distinguished native Officers. Should Her Majesty be graciously pleased to place upon her military Staff two native Aides-de-camp, to be relieved periodically, a means would be offered for creating a steady, but not too rapid, flow of promotion, for every Officer thus honoured would, of course, receive the rank of Captain, which he would retain on his

return to India. The more the native soldier can be induced to identify himself with the British Army, and the more he sees of the extent of our power as evinced by our ships and colonies, the more likely he is to remain faithful to our Government and attached to our rule.[1]

When Maharajah Jung-Bahadur, on his visit to England, was told by a Minister that he might possibly form an erroneous estimate of our power as compared with those of other European States, he replied that he was not likely to do so, as he had observed *en route* from India, that our flag was flying over every post worth possessing that he had passed. His Excellency's loyal support of our Government during the Mutiny was the happy result of his observations.

In accordance with the order recently promulgated in India, the number of Officers to be attached to each native regiment is to be increased: had, at the same time, their duties been re-defined, so as to place a European Officer in charge of every grand division of two companies, this would have been a move in the right direction, but apparently wing Officers are still to be left without any specific command, and thus one of the evils of the present system is to be perpetuated. The total number of Officers now authorized for regimental duty is 1,152,[2] whilst under the scheme I have submitted, the fixed establishment would be 1,752,[3] but in the one case the majority would in all probability be Field Officers, whilst in the other, one-half would always be subalterns, and except in the cavalry, there would be only two Field Officers to eighteen of the lower grades. Moreover, several of all ranks would be on Staff employ, so that even in a financial point of view, some advantage might ultimately be derived from the proposed change; but efficiency is much more to be regarded than economy, and I believe that most Officers who have served with native troops under a heavy cannonade would agree with me in thinking that if India is to throw her weight into the field against a European foe, and if she is to take her legitimate share of the defence of her own interests, she must be prepared to meet any enemy by whom her safety may be menaced; and it would be unwise to allow her battalions, with only eight European leaders, to confront a well-disciplined and well-officered force.

It must not be supposed that I am seeking to disparage native troops, on the contrary, having witnessed their gallantry in the field, I cannot but look upon them as brave and courageous soldiers, ready to follow wherever they are led, and for skirmishing or engagements needing a display of individual daring, perhaps unsurpassed by those of any nation in the world, but when manœuvring in masses, more especially if exposed to the effects of a withering fire, they must be commanded, and I hold that it would be impolitic to allow the reins

[1] A wise step in this direction has been lately taken by bringing the Indian Contingent to England.

[2] Cavalry, 248. Infantry, 904.

[3] Cavalry:—Lieutenant-Colonels, 24; Majors, 24; Captains, 96; Lieutenants, 48. Total 192.

Infantry:—Lieutenant-Colonels, 78; Majors, 78; Captains, 624; Lieutenants, 780. Total 1,560.

of command to fall from the hands of their European Officers, to be grasped by natives, to whom, whilst extending their influence and habituating them to the exercise of authority, we hold out no hopes of rising from their subordinate position. Should the organization I have suggested be adopted, in what might be styled the fighting battalions the European element of command would predominate, and the men would consequently look up solely to their European leaders: at the same time, the claims of the native Officer would not be overlooked, and, in the reserve battalions, where his influence would be most desirable in securing a supply of efficient recruits, he would obtain that recognition of his valuable services to which he is entitled, and from which, whilst his fellow-countrymen are rising to posts of dignity and emolument, it is unjust that he should be any longer excluded.

Although the armies of the three Presidencies would be united under one chief, who, for the purposes of inspection only, should be allowed a second in command, and thus, as regards the European Officers, local prejudices and local jealousies would disappear, the Madras and Bombay Regiments would still continue to garrison their own Presidencies, and recruit from their own provinces, so that a healthy spirit of rivalry would be created, a spirit that might effectually prevent any general disloyal combination against the State.

With an army of the strength and organized upon the system I have advocated, India would always be prepared to commence a campaign with a force of 50,000 highly efficient and well-trained troops, whilst she would at once call out a reserve of about 18,000; these would be available to fill up vacancies in the regiments moved to the front, at the same time the several reserve battalions would complete their ranks by recruits who would rapidly become qualified for the performance of garrison duty, so as to take the place of the older soldiers.

As the arms, accoutrements, and uniforms of reserve men would always be kept in store, there would be no delay in their equipment, and the moment that the order for the mobilization of a reserve battalion was issued, the men attached to it would join the head-quarter station for the performance of garrison duty until their services might be needed with either of their active battalions.

In the foregoing sketch I have merely shadowed out a general idea. Possibly, even if the idea was adopted, it might need modification in various details; for instance, it might be deemed advisable to retain the Goorkha Battalions on the irregular footing, making a corresponding reduction in the strength of each of the 78 regular battalions. I believe, however, that the principles I have enunciated are correct, and that, in order to secure efficiency combined with economy and sound policy, it is essential—

1. That the regimental system, with its proper proportion of European Officers, should be re-established.

2. That a scheme should be introduced for creating a suitable reserve.

3. That whilst avoiding any weakening of the influences of

European Officers, and of the tie that connects them with their men, suitable means should be afforded for the further recognition of the gallant and faithful services of native Officers.

By my persistent advocacy of a return to the regimental system, it may perhaps be thought that I am opposed to all progress, and am consequently unable to keep pace with the requirements of the age. I may, however, observe, that long before the Mutiny I was urging upon the home authorities the necessity for introducing changes into our military system, to avert the catastrophe I then perceived was pending, but I have deprecated the complete transformation that has since been effected, because, whilst I can recognize the advantages of salutary reforms, I always mistrust the results of revolution.

The CHAIRMAN: The lecture we have just listened to opens out a vast field for discussion, and I am afraid that many present will find the ten minutes laid down by the rules of the Institution hardly sufficient; but no doubt, by confining themselves to the salient points raised by Sir Orfeur, a very valuable discussion may take place, and I trust that many whom I see around me who are perfectly capable of discussing the several points, will give us the benefit of their opinions.

Major-General Sir JAMES HILLS, V.C., K.C.B., R.A.: I feel quite unequal to take up the questions in the limited time given me; because as Lord Chelmsford states, the lecture opens up a great field for comment. I am not quite prepared to pick out the points that I specially wish to speak upon. I think that the lecturer has been somewhat mistaken in his views as to the irregular system, because it is carried on very much in the old way. The Officers have special duties to perform, and it is all laid down in certain books. They have certain commands, and their whole time is very much occupied in the details of their work both in peace time and in the field. Also one would gather from this paper that there is a want of fellow-feeling and affection between the Officers and the men in comparison to what used to exist in former days. Now from what I have seen of the service, the Officers mix very much indeed with their men; they know them thoroughly. There is no Officer, either wing Officer or wing Subaltern, who does not know every man under his command. They are constantly in their lines, I think much more so than before the mutiny. Therefore I do not think that the present system would be bettered by returning to the other. With reference to the number of Officers required for the regiment, I think that the additions recently made, are good; but I myself wish for one more Officer. I would have a Lieutenant-Colonel commanding the regiment; two Majors commanding the wings; four Captains commanding companies, with two Subalterns as Adjutant and Quartermaster. That makes a total of nine Officers. Then the native Officers have full play for their own special duties. They are not too much interfered with by the European Officers, and each would have enough to do in following out what is laid down for him to do. The position of the native Officers has been very much improved lately. There is a native Adjutant and a native Subahdar-Major; and I think as a rule they are very fairly satisfied with their positions. The question of the reserves is far too elaborate for me to think of going into it without writing upon it myself. I could not get up and make remarks that would be worth listening to at a moment's notice, but there is no doubt that if after three years you gave every man the option of retiring to the reserve, you would have so many men on hand that you would not know what to do with them. A great many men even now take the discharge after three years without going to the reserve, especially men who come from across the border. I think the commanding Officers might have more power with reference to giving the men their discharge than they have now; but I do not think it would be advisable to give every man a chance of going to the reserve after three years; because you would find, I think, that almost every man would go. Nothing has been touched upon with regard to the elements of which the regiments should be made up—whether they should be kept as they are now—some of them of

a distinct class, or whether they should be mixed classes. For myself I prefer to have a special class in regiments. I think there would be a greater feeling of *esprit* than there is at present; but I must say that in many mixed regiments that I have seen it would be impossible to have greater *esprit* than you find in them now, and they hold their own both in discipline and everything else with those that are of a special class; but for the safety of the State I think it more advisable to keep them separate.

Colonel J. H. GORDON: I wish to make a few remarks on some of the subjects touched upon in Sir Orfeur Cavenagh's lecture. I have seen a great deal of the Bengal portion of the present Indian Army, and I have commanded a regiment for twenty-one years. I have not served with a regiment under the old system. With regard to the old irregular system under which my regiment was formerly, from what I saw of it, the system made the Officers, as they were entrusted with large powers of authority. This brought out their judgment and good qualities where an Officer had anything in him. But as we had the old musket and the fighting tactics, being those of close quarters, we did not require so much scientific leading as at present, therefore the European Officers were few in number. We cannot yet advance native Officers and make them Captains or Subalterns, or put them on a par in that respect, with the trained, educated English Officer. Sir Orfeur Cavenagh's ideas on this point are, I think, too far in advance. We demand a great deal from a young British Officer now in the way of scientific education before he enters the Army, and before he is promoted we demand a good deal more. We demand nothing in that way from native Officers except personal influence, which is no doubt a great thing, and a slight vernacular education. With regard to what has been said about native Officers being dissatisfied with their position because of the opportunities given to native civil officials, I have seen a great deal of native Officers, both infantry and cavalry, and the thoughtful ones among them know very well the different conditions of the military and civil services. As a rule they are uneducated men in our sense of the word; the educated native civil official must be an educated man and trained specially for the position. The classes from which we draw the native military Officers generally prefer the military profession. In my opinion the native Officers are contented men, but they would welcome a change in the pension system by which they could claim pensions after a shorter period of service than at present. That period was forty years a few years ago, now it is thirty-two. An invalid pension is available after fifteen years' service, but this works unsatisfactorily; after twenty years' service many of them long to get home and to retire, as there is no one else to look after the family estates and interests. With regard to wing Officers, in a well regulated native regiment where the commandant is a practical soldier, every Officer has something to do on parade and elsewhere, and in fact a great deal to do. Wing Commanders assisted by their wing Officers carry on all the musketry training, theoretical and practical. There are no musketry instructors in native regiments, and if you look at the musketry returns of the Indian Army the results are shown of very good shooting. This musketry duty keeps all the wing Officers very much employed, and it is going on a great deal the whole year round. The wing Officer has to take the place of a wing Commander on leave, to go on detached duty with two companies, and has a defined duty and position in field drill and operations under the present system. A young Officer has been trained in an English regiment before he joins the native regiment, and that is a great advantage, as he is at once ready for duty. The English Officer comes to make the native soldier, not as formerly to be made under the old system in the native regiment. With all due deference, I think, taking the present system all round, you will find a much larger number of practical Officers and soldiers now with native regiments than formerly. When we go on active service we certainly want more young Officers. That made itself apparent in the late campaign now and then; but the remedy for that is the establishment of a regimental reserve of Officers. I think I have seen in some Blue Book the proposition that all Officers allowed to go on detached military staff and civil duties up to ten years' service should be available for return to regiments on active service. This means the free application of the principle of seconding, and would supply a regimental reserve. We want double the number of young Officers for

active service for the increased important duties incident to a campaign and to a combined British and native force. After the capture of Cabul it was necessary to send for more Officers for the native regiments, to replace casualties, and those regiments left in India were used as a reserve of Officers. With regard to returning to the regimental or old system, I do not choose to give an opinion on that, as a regimental system can also be brought about in another way; I only know that there is a vast amount of *esprit de corps* now under the present system, combined with efficiency. The Officers as a rule are contented men, and professionally well trained. They are much better paid than formerly. Formerly the Officers were tempted off to the civil and staff departments, as there was small inducement to remain with the regiment, but now the emoluments attached to regimental duties have been placed more on a par with those of civil and staff duties, therefore the regiment has its attractions also. Under the staff corps system Officers know they will get promotion at a certain date, and with it increased pay. There must be some merits in this system of promotion, which has been applied lately to the corps of Royal Engineers. With regard to the Officers lacking interest in their regiments, my experiences have been quite the contrary. Of course there may be one or two such to be found here and there, but taking them as a body I do not think it can be said of them. I commanded a brigade during the Afghan War, and a great many native regiments passed through my brigade. I have seen a good deal of service of late years, and met many regiments, and have always seen the regimental Officers devoted to their regiments and men, and the native ranks responding to them. The British Officers have very hard work on such occasions, and it is well known how efficiently the work has been done by the native Army. Efficiency, *esprit de corps*, and the bond of union between Officers and men, go together. With regard to a reserve of men, that is another question, which I believe has been under consideration. I think recruiting depôts are wanted; and there we might employ men not fit for the arduous work of a campaign, and native Officers of local influence with increased native rank and power. We have a native Adjutant in both infantry and cavalry regiments.

Sir Orfeur Cavenagh: That is what I suggested years ago. That part of my lecture was an extract from what I wrote in 1857.

Colonel Gordon: A great deal has been done of late for the native Officers and the ranks. With regard to native troops under a cannonade, I may say that I saw our native infantry twice under the fire of the Afghan mountain guns, and they behaved very steadily and coolly. In the Afghan War, the fire discipline of the infantry was the result of very marked excellent field training. Ammunition was most economically expended. I attributed very much the small loss sustained by the troops in action in Afghanistan to our excellent straight shooting, which quickly drove off the enemy and enabled us to gain positions with little loss. In the former Afghan War our troops fought under very different conditions as to arms.

Major W. G. Thomas: Perhaps it is presumptuous in me to address you on the subject of the Indian Army, as I have not the honour to belong to that force. On the principle that lookers-on see most of the game, perhaps I may be considered to know something about it. I have been a long time in India, and have a great number of friends of all ranks in the Indian Army. With regard to the proposition to return to the old regimental system, which means to double or treble the present number of Officers, it appears to me that it would be a very fatal step. The objection made to the present system seems to be that there is no definite duty for the Officers. If that is so, to increase their number would fail to give them a definite position. If you cannot give a definite position, and suitable work, to seven men, it is impossible to give it to twenty-one or twenty-eight men. The old system was tried, and found wanting. That great soldier Sir Charles Napier, when he left India, published a memorable General Order describing the position of the Officers of the native Army. It is to be inferred from that order, that from want of a definite position and duties a number of Officers under the old system, instead of studying their profession, and devoting themselves to their regiments, spent a great deal of time in amusement and dissipation. At the present moment there are

seven Officers in a native regiment, and each has his time fully occupied. What with musketry and drill there is now an abundance of work for every Officer, a great boon in a country like India.

A great deal has been said of the "inexpensive charger:" he has been a standing joke for many years; but it seems to me that the work done by the "inexpensive charger" is such that if he could give his opinion he would not at all agree with the lecturer that the wing Officer had not a defined position. With regard to providing an outlet for native Officers, I fail to see how relegating them to the reserve would be considered by them at all a boon. The present system is only the beginning, I believe, of a greater career for the natives of India. Now they have their defined position as Subahdars and Jemadars, and if they are to be deprived of that by increasing the number of English Officers in a regiment they will have nothing to look forward to.

Lieutenant-Colonel TYRRELL: I am a wing Commander, and wish to give my views on the wing system. There are certain fixed principles of military organization, and one of them is the establishment of a definite chain of responsibility from the lowest to the highest—soldiers are formed in companies under the command of Captains, and a convenient number of companies is formed into a battalion, the Captains responsible to the battalion Commander. That is the case in all the armies of civilized Powers except the Indian Army, where there has been a link added between the company and the battalion, that is the wing. The company Commander is responsible to the wing Commander, who is responsible to the battalion Commander; and the companies are commanded by native Subahdars, and the wings by European Officers: but the fact is that the company command is really divided between the Subahdar and the wing Commander. The Subahdar leads the men on parade, and the wing Commander deals with the interior economy of the company. The division of duty is not strictly laid down or defined; it is pretty much at haphazard. I think that is objectionable. The Sepoy hardly knows whether he is commanded by his Subahdar or by the wing Commander: for some things he goes to the Subahdar, and for some he goes to the wing Commander; and the Subahdars, who are supposed to command the companies, are really not responsible for their own companies. The wing Commander's duties are simply to do the company Commander's duties for him, and to act as Major on parade; part of the duties of a company Commander, the Subahdar, however otherwise efficient, is not capable of doing, because he does not know the English language. In many cases he is not fit to be trusted, therefore he has a European Officer to look after him. The wing Officer has to assist the wing Commander in doing the company Commander's duty for him: in fact there are two wing Commanders and two wing Officers kept up in every battalion of infantry, simply to see that the company Commanders do their duty, and to assist them in doing their duty. I think it would be a much better plan if there were a European Officer commanding each company directly responsible to the battalion Commander; or I think the old irregular system was very good, where the native Officer really did command his troop or company, and was responsible to his regimental or battalion Commander. I think both those systems are good. I belong to the Madras Army; and in that army the native Officers are not as a rule fit to command companies, and really they do not. They only do the duty of colour-sergeants, and a European Colonel or Major has to do the duty of Captain for them; and he is often overworked, having to do that duty for four companies, and very often has not a wing Officer to assist him, the wing Officer being frequently detached on some duty, or the regiments being short of European Officers. There has been a proposal to double the number of European Officers, and to put a double company under the command of a European Field Officer; but that is rather increasing the evil of having a great number of Officers between the battalion Commander and the company Commander. I think in the Madras Army, at all events, there should be a European Captain at the head of every company. You may have four companies instead of eight if you like. I think the native Officers can do the duty of subaltern Officers very well, and the Lieutenant of the company might be a native; but to lead Madras Sepoys, European company leaders are absolutely necessary. Sir Orfeur Cavenagh spoke of having a Reserve in the Indian Army, but I do not

think a Reserve could be worked profitably along with voluntary service. All the natives of India enlist for long service, and the Madras Sepoys generally stay in the regiments till they are obliged to be invalided. But I think it would be a very good thing to have a division of the army into field and garrison battalions, as proposed, and when a man is unfit for field service draft him into a garrison battalion; but of course if you send men into the Reserve you have to pay them while they do no duty. When they have enlisted voluntarily, they will not stay in the Reserve for nothing. In that case I think the game is not worth the candle. We have always had native Adjutants in the Madras Army. You know the Madras Army did not mutiny; and in fact nothing in it was changed except the *cadre* of European Officers. The system was not changed at all, and exactly the same duties formerly performed by the European Captains of companies are now performed by the European wing Commanders, except that they have four companies instead of one to look after. I think the new organization works rather badly under the old system. The Bengal Army is different, because that army was newly raised, and the new system was more adapted to it, because it was the system actually in force in the newly raised army at the time.

Major-General Sir HENRY HAVELOCK-ALLAN, Bart., V.C., C.B.: I should like to be allowed to offer a few remarks on this subject, probably as interesting a one as can occupy any assemblage of Englishmen, and one which is becoming in its bearings more and more important, and of increased national interest every day. I think this Institution, and the gentlemen here assembled, are very much to be congratulated on the fact that they have been addressed in the first instance by Sir Orfeur Cavenagh, than whom probably scarcely anyone now living has any greater experience of the old system of the Indian Army. We have also had the opportunity of comparing with his views, the views of Officers of high distinction who have served with the newly organized system, such as Colonel Gordon, an Officer who unites with the experience gained under the purely British regimental system in the old days the practical experience of having commanded a regiment, and afterwards a brigade, of native troops, and subsequently a larger force in the more recent events in India. Therefore we may say we have united the two extremes of experience in the discussion, beginning with forty years ago and coming to the latter days, in which Sir James Hills and others have been able to illustrate the fact that the native Army has at all events shown itself to be under capable leaders not in any degree below the standard of the reputation it gained for itself a hundred years ago. The questions of practical interest which have been elicited by Sir Orfeur Cavenagh's very able paper seem to me to resolve themselves into whether a return to the old regiment system of a very large number of European Officers would be better, or whether the existing system of seven European Officers would be better, or whether it would be better to adopt an intermediate system, utilizing the best points of both, and avoiding the faults of either: that is, having with a medium number of European Officers a considerable proportion of native Officers. I think on one point we are all agreed, that is to say that any mode of organization which would entirely check the aspirations and ambition of our native Officers would be a retrograde step in the last degree, and one which we should desire to avoid; therefore in all discussions as to any medium between the old system with about twenty-four native Officers and twenty-four European Officers, and the new system, which has five or six European Officers, and a large number of native Officers, the object is to have exactly that number of European Officers which shall secure complete and efficient leading in the field, consistently with the large casualties which would be incurred in any campaign with modern arms against a modern army, and, on the other hand, to leave a sufficient scope and outlet for the energy of the native Officers, by giving them the opportunity, if they showed exceptional talent, of rising to a higher position than that of Subaltern or Captain, which is the utmost limit to which their ambition can now rise. Therefore the question resolves itself into the means by which an outlet can be found for the ambition of the native races (who are showing increased capacity in that way every day) by the greater infusion into our native Armies of such classes as Colonel Gordon had the happiness to command—Afghans, Sikhs, Bhotans, Goorkhas—and at the same time preserving sufficient European Officers to meet the casualties in a campaign on a

larger scale than was seen three years ago. After watching during the past seven years each change in organization, it appears to me that the happy medium we all desire would be best attained by having an organization somewhat half-way between that proposed by Sir Orfeur Cavenagh, and that proposed by those who are of opinion that the present number of European Officers is entirely sufficient for all practical purposes. Major Godfrey Thomas alluded to that which is well known—that one of the greatest difficulties which military reformers have to avoid is the having a superabundance of European Officers who in times of peace have no outlet for their energies, and who would be simply idle, wasting their time in other pursuits, and therefore would not be so well, *pro ratâ*, accustomed to their duties as those of whom Colonel Gordon has spoken, who, being few in number, and having their time fully occupied, are, man for man, perhaps better Officers than those under the old organization. To obtain that object perhaps the best way would be, as regards the native battalion, to have two native Officers, then four European Captains to command each of them, a double company united for that purpose on parade; and then, consistently and conjointly with that, three or four British Subalterns, one Adjutant, one Quartermaster, and two supernumeraries; but I would retain the present command of the eight companies by a native Officer, who, as Major Tyrrell has pointed out, would be far better employed, where he showed capacity, in having the entire control of his company. That would give this result: that you would have in each regiment four double companies, whose general superintendence and whose immediate leading on necessary occasions would be performed by a European Officer, who would command the united companies, while the native Officer would not feel himself in any sense deprived of the position of honour derived from the fact that he retained the full command of his individual company. But there is another point which perhaps is of still greater importance. It has been sought by all those who have had the greatest interest of the natives of India at heart, and have seen that it was necessary that some greater outlet should be provided for them than the present system gives, to see how it was possible to unite occasional opportunity of falling into still higher positions of command with that proved necessity of the actual leading of the men of any unit bigger than a company being confided to European Officers in action; and it has often struck me that it is wonderful, considering the vast amount of talent and energy that is to be found amongst the millions whom we have under our control in India, that we should be able to find men who are prepared to endure all the privations and hardships in the comparatively unimportant and unprominent position of native Officers, knowing that their career is barred by the fact that they cannot rise to any higher rank than native Captain. Now the French, whose position in Algeria is somewhat analogous to ours, have solved that difficulty in a manner I think peculiar to their Algerian Army, but which I do not think will commend itself to us. They have allowed the command of one squadron, or even two, or occasionally a native regiment of Spahis, to fall into the hands of a native of Algeria. Well, if, conjointly with other and greater political considerations, it were possible that we could do that in India, then undoubtedly the object we are aiming at would be reached, and would be as a prize put forward to natives of India of high military capacity (as undoubtedly there are hundreds of them), and you would there satisfy their highest aspirations. We are often told by those who have studied the military history of India in former times, that that is the reason why our armies have deteriorated in the present compared with the past, when it is said a native Officer often commanded a native battalion or a regiment of cavalry. It seems to me quite possible, by the adoption of a remark which Sir Orfeur Cavenagh threw out, to retain those two opposite and conflicting conditions, and still give an outlet to native ambition, whether by the creation of reserve battalions in which in some instances the command might be entrusted to natives, or by having on our establishment a small proportion of regiments, say $\frac{1}{5}$th or $\frac{1}{6}$th of the whole, in which it might be recognized that the command might eventually fall into the hand of a native. In some such way I think an outlet should be afforded which the present system does not give, and we should avoid this difficulty, that whereas, if at present, by a great extension of native Officers, you were to eliminate the European leading element altogether, that would be a defect of the worst sort,

while on the other hand you would be able occasionally to give to a native of exceptional military talent such position as might be held out as a prize, and, at the same time, would maintain the present general efficiency, by having the double companies and squadrons for the most part still commanded by European Officers. One of the most prominent matters that has attracted my attention with regard to the changes that have taken place in the native armies and their ultimate effect, is one which will force itself home to the mind of everybody who has seen the altered position of late years as regards other forces. To use an expression which has become somewhat a cant one, I think it must be admitted that the contingency, at one time completely removed, of our having to put an army in the field composed in a large measure of native regiments against an army which might be materially, if not entirely, composed of Europeans, has increased within what we may call a very measurable distance. It may be remote, or, on the other hand, near at hand, but no statesman having the responsibility of dealing with the organization of the native armies of India, for the future, I think, would be justified in leaving it out of consideration as a possible contingency, and we should endeavour in all the changes we desire to make as regards organization to keep that within our view as a contingency that may overtake us at any time. The practical question as to how far the command should be allowed to be concentrated in the hands of Europeans, or how far it should be subdivided between natives and Europeans, and what proportion the one should bear to the other, is a question which in importance and practical value is attaining larger dimensions every day.

General NEWALL: I should like to be allowed to put one question. Some of the remarks of the lecturer pointed to a "reserve." I assume that as his lecture is on the Indian Army, any incorporation of an European reserve does not enter into his consideration?

Sir ORFEUR CAVENAGH: Purely the native Army.

General NEWALL: I pass on to remark that on a recent reduction of certain battalions in the Indian Army, it was hoped that the soldiers discharged would immediately enlist into other regiments, preserving their term of service and other advantages; but it was discovered that they preferred to take their gratuities, and so become merged in the population; not to become, I should hope, swashbucklers in the armies of the native potentates; I have always thought the time has arrived to incorporate these armies into an army of reserve, if possible. I should like the lecturer in his reply to favour us with any information or suggestions on that particular branch of a native reserve for India.

The CHAIRMAN: I should not like the discussion to close without rising to make a few remarks regarding the lecture, because I have, for an Officer belonging to the British service, had exceptional opportunities of noticing the native Army, not only in one Presidency, but in two, or to a certain extent in the third. For eleven years I served in the Bombay Presidency with a British regiment, and part of the time in the field with Bombay regiments. During the Abyssinian campaign, I saw all three Presidencies represented, and for five years I was Adjutant-General in India, during which time I had the privilege of taking up to the Commander-in-Chief every question regarding the native Army which came to the department. There is no question that the difficulty of reorganizing the native Army must be very great, and the Committee which has been lately assembled in India must have found it so, seeing that the Blue Books published on the subject would make a high pile. After the mutiny the Bengal Army disappeared, and it was then decided by those who were in power that the whole Indian Army should be reorganized upon what is called (but rather I think improperly) the irregular system. It was neither the irregular system nor the regular system, as Sir Orfeur Cavenagh points out. It was a compromise between the two. I think that those who reorganized the three armies of India in that way, lost sight to a great extent of the impossibility of adapting one system like that to the whole of the troops which garrison India. Even in the Bengal Army there is as much difference between one class of regiment and another, as between a regiment in one Presidency and one in another. I think that our army reformers, after the mutiny, rather seem to have adopted the principle of that famous robber of ancient days, Procrustes, whom no doubt you all remember, and who used to put his prisoners on a bed: if they were too long

he cut their legs off, and if they were too short he stretched them to it. That appears to me to be the principle upon which the native Army was reorganized. But that is past and gone, and the question is, what can be done to improve the present system? There is no doubt that the Army Authorities soon discovered that the new system did not work, and that the number of Officers with it was not sufficient, as they began with five and have now increased to eight. That number of eight has also invariably been increased when regiments have gone on active service. I can speak myself from the experience of the Abyssinian campaign, that the demand for Officers was so great that at last a Bengal Officer said, "We have given you all we can, and you are authorized to stop any Officers coming back to India from furlough in Egypt, and make use of their services." In Abyssinia, we lost scarcely any Officers, and how was it there was this demand for Officers? Simply because the demands for the Staff were so great. Staff appointments sprang up in all directions. There were nearly 400 miles of communication, and a very large land transport, so that absolutely in that small army, I believe I am within the mark when I say, there were no less than 132 Staff Officers employed in different capacities. Under the present system, there is no reserve of Officers, and several speakers have this afternoon pointed out that that is a very great want. Of course I have not that acquaintance with the details of command which those speakers have who have given their opinions this afternoon, but I really question whether the eight Officers now with the native regiments, seeing the multifarious duties they have to perform in peace time, are sufficient. Musketry alone takes up a great deal of time, and then all the paper work is a very severe tax upon the Officers, a certain proportion of whom are always on leave. Then when you have all the Officers mounted in an infantry regiment it is a very difficult thing on parade in peace time to know what to do with them. I have seen seven or eight mounted Officers on parade, each in the other's way, because in the field exercise book the drill is only adapted for four mounted Officers, and with four others in addition, it is difficult to know what to do with them. Some alteration is absolutely required, but how that alteration can be accomplished passes my comprehension altogether. With the present system of the Staff Corps, with the certain promotion that Officers get, and the good emoluments they receive, there is no inducement to retire. Therefore the proportion of field Officers must become very great, and Officers naturally would object to go on foot when they consider their rank entitles them to be mounted. With regard to the discipline of native regiments, I can certainly say, from my experience as Adjutant-General, that nobody could have any cause of complaint with regard to that point. Commanding Officers have now very greatly increased powers. Some of those powers were taken away when I was Adjutant-General, but I think it was unfortunate. Because one or two Officers abused that power, or perhaps did not understand how to wield it, the good Officers were made to suffer and their powers were restricted. There is no question about it that a commanding Officer dealing with natives must be entrusted with the fullest power, and the native must look to him and feel that from his decision there is no appeal. What produced the mutiny, in my opinion, was the want of discipline in the old Bengal regiments. The commanding Officer was set on one side at head-quarters, and when a Sepoy appealed to head-quarters, the authority of the commanding Officer was too often ignored in favour of the petitioner. So far as discipline is concerned, I think that we may safely leave that in the hands of the present class of Officers. My experience, which, however, only dates to 1874, when I left India, certainly agrees with what Colonel Gordon said. I am satisfied that on any occasion when the Officers of the native Army of India are called upon they will not be found wanting in any respect. With regard to the organization, I think that everybody here will admit that an army is not to be organized for peace time, but for war, and the question, which it may be useful perhaps to discuss shortly, is as to whether the native Army under the present conditions is as well adapted for war as it might be. My own impression is that it is not. I hold a very strong opinion—I do not know whether it is shared by the majority here present—that, as Sir James Hills said, and as I know Colonel Gordon holds (because he wrote a paper on it for the United Service Institution of India), class regiments would be a very great improvement. At the present time, the organization which was adopted generally after the mutiny

is that of class companies and class troops. In some regiments there are no less than six different classes. That, I think, militates very much against the military efficiency of the army. Although in a good regiment no doubt *esprit de corps* will exist in spite of every difficulty, yet it makes it very difficult. Nobody who has been in India will deny that caste influence is enormously powerful, and you cannot ignore it. At the present moment, it appears to me that we do not use that influence in a manner to make the army efficient. The regiments that were employed principally during the Afghan campaign in prominent positions were virtually class regiments. The Goorkhas of course were purely class regiments; the Punjaubee regiments were composed of Punjaubee Mohammedans and Sikhs, and there were besides two regiments of Musbi Sikhs, and two purely Sikh regiments. In mixed regiments, recruiting and every part of the interior economy of the regiment becomes most difficult, and on service it is, I believe, extremely detrimental to the best interests of the country. If we had a class brigade in the field, composed of three different class regiments, you could then rouse those class prejudices and use them to your own advantage, and you would have the wholesome rivalry of three different classes in the same brigade, each vying to show that his class was the best. Therefore, I trust among any changes that may take place, one may be the reduction of a number of classes in one regiment, if not purely the adoption of class corps. I could go on talking for any length of time on the subject of the reorganization of the Indian Army, but I wish to confine myself to what I feel may be of interest to those present. Of course, the reserve question is the most difficult, and I am sure I do not know whether that difficulty will be able to be overcome. There is no doubt that no army can be considered perfect without a reserve; at the same time it would not do, I think, to encourage men who have only served three years to go to the reserve. It would be getting rid too much of the useful element in the regiment, and you may be replacing it, perhaps, by others not so good. The best system of reserves I have ever heard of in India is that in the army of the Maharajah of Cashmere. When I went there with Lord Napier, I saw a regiment that had a third of its full war strength on parade. Two-thirds were away at their homes, only one-third drew pay. Each man had two substitutes, and one of those might come at any moment and replace the other, and then that one would go back to his home, so that the regiment had a two-thirds reserve at home costing nothing at all, but only one-third employed during peace time. I inquired about the system, because it was such a novel one, and it seemed to work remarkably well there, and to be very popular indeed. As long as the one-third were present and efficient, that was all that the commanding Officer asked for. I am glad to find that Sir Orfeur Cavenagh recommends that, while having one Commander-in-Chief, the Madras and Bombay Armies should be kept distinct. It is most important in India that the Presidential armies, no matter under what names, should be kept distinct; and it would be a fatal day for India if the whole army was ever allowed to become homogeneous. The objection that I have to mixed regiments is that in them the edges of all the little class prejudices become rounded off, and the regiment, consisting of four or five different classes, becomes homogeneous, and I do not think that the political safety required in the hour of danger would be found there. I believe if the strongest dominant class in such a regiment were to mutiny, all the others would follow, just as the few Sikhs that were in the Poorbeah regiments did during the mutiny.

Sir Orfeur Cavenagh: My task has been considerably lightened by the remarks that Lord Chelmsford has been kind enough to make; whilst he has generally concurred in most of my views, he has certainly answered many of the objections that have been raised. My friend, Sir James Hills, has spoken in praise of the present system, but at the same time advocated an increase of Officers. Colonel Gordon, too, has spoken highly of the existing system, but he also thinks an additional number of Officers necessary. If the system is so perfect, it is strange that this increase should be needed. It must be remembered that Sir James Hills has never commanded a native battalion, whilst although Colonel Gordon has a thorough knowledge of the working of the new system, he had no acquaintance with the old one. I served for many years with a

regular regiment under the old organization, as well as with a corps of irregular cavalry, and therefore claim to have some knowledge of the interior economy of a regiment under both systems. Major Thomas, in alluding to the old army, stated that owing to there being so many Officers they passed their time in amusement and dissipation. I am afraid Major Thomas has very little knowledge of the subject. In the first instance the Officers did not exist in such numbers. There was hardly a regiment with more than twelve present (which would give a Colonel, Major, eight Officers commanding companies, an Adjutant, a Quartermaster, and perhaps a young subaltern not passed his drills), whilst many battalions had not an Officer at the head of every company; thus there were no more Officers than were absolutely needed, and every Officer had a distinct duty to perform. Both Sir James Hills and Colonel Gordon have told us that at present Officers have distinct duties to perform, but they have failed to specify them. I have been unable to discover what are the duties of the mounted wing Officers on parade. Are they to follow their wing Commanders and shout to the men to obey their orders, or are they each to take the distinct command of a definite body? I am of opinion that every European Officer should have a distinct command, for the efficiency of which he should be responsible, whether that command should consist, as Sir Henry Havelock has suggested, of a grand division of two companies, or of one larger company of 180 or 190 men. I hold that every Officer with a native regiment should have a defined command or distinct duty to perform, which is not the case at present; even on parade, they have no duties prescribed by written regulation; their employment depends upon the caprice of their Commanding Officers; this is not a wholesome state of affairs, for you may be assured that if you allow the influence of European Officers to diminish, and the reins of command to fall into the hands of natives, some day the result will be disastrous. Colonel Gordon considers that native Officers are perfectly satisfied with their present position; I am inclined to think he would change that opinion if he heard their remarks when contrasting their pay with that of the Moonsiff[1] or other civil Officer. As regards Major Thomas's allusion to the inefficiency of the Officers of the old Army having brought about the mutiny, as I stated before, he evidently knew little about them. At the same time it must be remembered that the whole system of military instruction has improved, Officers in former days had not the same scientific training as at present, though they were not the worse soldiers. Lord Chelmsford has, however, explained to you the causes of the mutiny; he has told you that Officers had little power, they were mere cyphers at the head of their regiments and companies, hence the men had no confidence in them. When I was in command of a corps of irregular cavalry, a trooper was guilty of gross insubordination to the Brigade-Major. He was tried, found guilty, and sentenced to dismissal: a light sentence, which I confirmed. Some time after he returned to the lines and informed the men that he was to be reinstated: sure enough an order to this effect, and implying censure on myself, arrived from Simla. I, of course, felt this deeply. I accordingly wrote to Headquarters, sending a full report of the matter, and stating that as I felt convinced His Excellency the Commander-in-Chief could not have been aware of the circumstances of the case, I hoped I might be pardoned delaying carrying out the order until further instructions. My letter was never answered, and consequently the trooper was not reinstated. How can you expect Officers to acquire an influence over their men and maintain discipline if all power is taken out of their hands? In justly pointing out the inexpediency of placing European and native Officers with equal rank in the same regiment, Sir Henry Havelock has suggested that there should be merely four Captains to a regiment: this is the organization I have recommended for the cavalry, where there should be four squadrons, with four squadron leaders in addition to the Colonel and Major; but I consider it advisable that infantry regiments should be fully officered. As a rule the native Officers of infantry are not equal to those of the cavalry, and the men therefore would require more leading; besides the whole of the Staff would have to be supplied from the native corps; therefore, although I have estimated the

[1] Third class judge.

number of Officers as twenty per regiment, there really would not be more than about twelve present; but in the event of war the remainder would be available to rejoin.

Colonel GORDON: That is merely a reserve of Officers in another way.

Sir ORFEUR CAVENAGH: Colonel Gordon forgets that there is such a thing as *esprit de corps*, but I am old fashioned enough to think that *esprit de corps* is very necessary in every army. If you order four Officers who have never seen the regiment in their lives to suddenly join the 40th or 41st, do you think the men will have the same confidence in them as in Officers under whom they have previously served? I am happy to say that the Officers of the Bengal Army were never found deficient in zeal for the service. When the first Afghan war occurred, an order was issued to the effect that Officers were not to volunteer, but when required they would be duly summoned, because every Officer on the Staff belonging to corps warned for service immediately requested permission to throw up his Staff appointment and rejoin. These men, though many perhaps had been absent for years, had pride in their regiments and felt that their own honour was bound up in their good name, and consequently were prepared to make any sacrifice in order to be with them. Although I was not very long with my regiment, for years afterwards I was never in any place where any of my men were near me without their coming to pay their respects and talk about the corps. Would they take the same interest in reserve Officers having no connection with the regiment, and suddenly required to join it? Moreover, in what manner are these Officers to be ordinarily employed; are they to lead idle lives and lose all their military knowledge? Two of the speakers have stated that under the system I have proposed too many soldiers would join the Reserve, whilst a third has, as distinctly, asserted that no man would join. I am therefore induced to hope that the happy medium would be obtained. With regard to Lord Chelmsford's remark, I would observe that I have fixed the period with the colours at three years, with the view of securing the services of men who, under existing regulations, are entitled to claim their discharge after having served that time. Of course transfers to the Reserve would be dependent upon there being vacancies in the Reserve battalions. In conclusion, I would remark that I am not wedded to my own idea, but I am satisfied that, to ensure efficiency and economy, any schemes that may be submitted for the reorganization of the Indian Army should be based upon the lines I have laid down, viz.:—

1. The re-establishment of the regimental system.
2. The promotion of a reserve; and, lastly,

The improvement of the position of the native Officers.

Colonel GORDON: I said it was the application of the seconding system. You say there should be twenty Officers in a regiment, of whom under the old system say ten were present. What I said was, second freely. Let me have eight or more on staff service, and call them up for active service, and I think that is what I referred to as the reserve of Officers in the Blue Book. I think it is one of the proposals for a reserve of Officers by General Norman. I think he proposed that after ten years' service the Officer would no longer remain on the regimental list. But he had been in the regiment, and the men would know him when he rejoined. Such Officers even now who have served in regiments are often sought out by their men when on leave, and called upon in a friendly way as of old, which shows the good feelings still maintained. The native soldier is now, exactly as he was, very much attached to the English Officer he has served under, and the Officer to the men. I think you misunderstood me. I say, second freely to supply a regimental reserve. Just now we have eight trained Officers permanently attached to battalions. Under the old system, I have heard of a regiment with three or four only; but you then called the absentees up from civil and other duties for war service. Under this system I refer to, up to ten years' service an Officer's name would be borne on the rolls of the regiment; that is, seconded, but available for active service. At the end of ten years, his liability would cease, his name would be struck off the regiment, but another junior could be at once added. These Officers should all have passed through the regiment.

Sir ORFEUR CAVENAGH: That is the very system I have advocated.

The CHAIRMAN: I think there has been a misunderstanding.

Colonel GORDON: I never said strangers. I said Officers; by the application of the system of seconding, letting Officers go freely from the regiments to the staff and other duties, who would still up to a certain time be connected with the regiment.

Sir ORFEUR CAVENAGH: That was the old system, and it was the system under which an Officer kept up the interest in his regiment throughout the whole of the service. Much has been said with regard to the improved discipline of regiments, and the superiority of Officers at the present day; but you must remember that the whole world is progressing, that the Indian Army is not different from other bodies. Has not there been a great change in the home army? Every Officer is bound to have a thorough military education, which was not the case in former days. Therefore, the great change of organization has no relation whatever to these improvements. It is simply the fact that our whole system has changed. I was asked to allude to the Reserves. I have only thrown out a general hint with regard to what I consider right as to the formation of the Reserves; but it is very strange that while one speaker thinks all the men would go to the Reserves, another stated that nobody would go. I believe a certain number would go; for as every soldier is entitled to take his discharge after three years if he chooses, I think if the men who now take advantage of this right were told that they might join a corps located in the neighbourhood of their own villages, and only turn out once a year, we should retain their services. I am not in any way wedded to my own opinion, although to the three points I laid down I do adhere. I do say we should have some better system of regimental organization, under which every European Officer in a native regiment should have a distinct command, and be responsible for its efficiency. I equally say it is essential that we should offer more inducements to native gentlemen to enter the Army, and make them contented with the service. I consider it is essential, even as a matter of justice to the natives of India, that whilst as civilians we allow them to rise to the highest position, we should give some greater opening than hitherto to the native soldier. I acknowledge that it is impossible for us to have native Officers holding equal commands in the same regiments with Europeans. We must keep them distinct. My scheme may perhaps not be the best, but it is a plan for remedying existing defects, and is therefore worth consideration. I certainly adhere to the opinion that I have expressed upon the three points upon which I have laid stress. At the same time I am quite open to any suggestion. I know that I am not infallible. I think that possibly many here could improve very much upon my idea, but I am sure that whoever would attempt to improve the system now in force, must work upon the lines I have prescribed. I thank you very much for listening to me.

Sir JAMES HILLS: Sir Orfeur Cavenagh would lead gentlemen to infer that I have had very little experience with natives. I commanded a native battery for three years; I commanded a station composed entirely of native troops for over a year; I was Assistant Adjutant-General, and saw the inspections for four years.[1] Therefore, although I never commanded a native regiment, I may rightly say I am very well up in the economy of a native regiment.

The CHAIRMAN: I am sure we are very much indebted to Sir Orfeur Cavenagh for his lecture, and I think the discussion which has resulted from it has been extremely interesting, and I trust of some value. I am sure you will all join with me in giving a vote of thanks to Sir Orfeur Cavenagh for his very able lecture.

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[1] N.B.—I should like to add here, if this is permissible, what I had intended adding at the time, "and myself conducted the inspection of several native corps, cavalry and infantry, when they were under my command in the field."

Friday, June 23, 1882.

GENERAL SIR J. LINTORN SIMMONS, G.C.B., R.E., in the Chair.

THE NEW GREEK FRONTIER—HISTORICAL, ETHNOGRAPHICAL, AND GEOGRAPHICAL.

By Major J. C. ARDAGH, C.B., R.E.[1]

The CHAIRMAN: Ladies and gentlemen: I have to introduce to you Major Ardagh, who is about to give us a lecture on the Greek Frontier. Major Ardagh having accompanied the Mission to Berlin in 1878, under Lord Beaconsfield, being present at the Conference in 1881, and since then having been Her Majesty's Commissioner for the Delimitation of the Greek Frontier, has had exceptional opportunities for studying the subject. I am not acquainted with the details of his paper, but I confidently recommend what he says to your attention.

THE subject upon which I have been asked to address you to-day is new, in the sense that it deals with a settlement lately accomplished: but it is not only old, but even ancient, when regarded from that point of view—more or less familiar to most of us from our early education—from which we have been accustomed to contemplate the Greeks. The very essence of the intense interest which has been manifested by European nations in Greece during the last sixty years proceeds from her ancient history, and from the literary legacy which she has bequeathed to all posterity. Perhaps we have been entranced by the glamour of her poets, the rhetoric of her orators, or the subtlety of her philosophers; but the fact is absolutely incontestable, that no one has been able, or even desirous, of resisting their charm. It is not my province to dwell further upon these considerations; I have only alluded to them in order to excuse, or justify, the course which I propose to pursue.

When a proposal to rectify the Greek Frontier is made, it is only natural to ask, who are the Greeks? Where is Greece? and what would be a fair frontier? In endeavouring to answer these questions, as a preliminary to the description of the new frontier, I must revert to their early history; but, as I advance, I must beg to be excused from entering in any way into political questions of a contemporary character.

In order to clear the field, it will be as well to mention certain geographical names which convey to most of us definite ideas: namely, Greece, Thessaly, Epirus, Albania, and Macedonia. These definite ideas are for the most part groundless when analysed; but they will serve their purpose. They are, or have been, what mathematicians would call "variable functions," now large, now small, now evanescent. The names have, however, been applied to districts

[1] Now Brevet Lieutenant-Colonel.

little known to geographers, very loosely defined, yet to a certain extent crystallised in a form which is known to us all; which can be found in any atlas, and which is therefore convenient for reference. Besides these geographical names, there are a few ethnic designations to which I wish to call attention at the outset.

First of all, there are the Pelasgians, the bugbear of historians, and the most ancient race to which it will be necessary to allude. These Pelasgians belong to the Indo-European stock, as contrasted with the Semitic and Turanian families; and the general direction of their movement was eastward; commencing, as far as we know, in Asia Minor, and extending westward across Greece to Italy.

Strabo says that "almost all writers agree that the Pelasgians were an ancient tribe spread over the whole of Greece;" and he mentions as Pelasgian, the island of Lemnos, and certain settlements therefrom in the Khalkidic Khersonese; the district of Pelasgiotis in Thessaly, and the Epirote nations in general.

Herodotus, writing about 430 B.C., says: "What the language of the Pelasgians was, I cannot say with any certainty. If, however, we may form a conjecture from the tongue spoken by the Pelasgi of the present day, those for instance who live at Creston above the Tyrrhenians, who formerly dwelt in the district named Thessaliotis, and were neighbours of the peoples now called the Dorians; or those again who founded Plakia and Skylaké upon the Hellespont, who had previously dwelt for some time with the Athenians; or those, in short, of any other of the cities which have dropped the name, but are in fact Pelasgians; if, I say, we are to form a conjecture from any of these, we must pronounce that the Pelasgi spoke a barbarous language. If this were really so, and the entire Pelasgic race spoke the same tongue, the Athenians, who were certainly Pelasgic, must have changed their language at the same time that they passed into the Hellenic body, for it is a certain fact, that the people of Creston speak a language unlike any of their neighbours; and the same is true of the Plakianians; while the language spoken by these two peoples is the same." Herodotus further describes Achæa (Ionia) and Arkadia as Pelasgian.

Homer uses the epithet of Pelasgic to the Dodonean Jupiter; and both Homer and Æschylus make Argos Pelasgic, the latter authority extending their sway to the River Strymon.

The most conspicuous monuments left behind by the Pelasgi are their fortresses, structures built of large polygonal blocks of stone with uncemented joints, and generally known as Cyclopean. These strongholds, the Pelasgic designation for which is *Larissa*, are to be found in Greece, in the west of Asia Minor, in Epirus, and in Italy. Several lie near the line of the new frontier, at Arta, Dodona, Tchouka-Generalis, Smolia, and perhaps Gritzianon and Tchai-Hissar, but the last two are chiefly of the Byzantine period. It may be inferred from the frequency of these fortresses that the Pelasgi were a sedentary and perhaps an unwarlike race.

The Greeks, then, were preceded by, and apparently sprang from, the Pelasgi, whom they either assimilated or expelled in prehistoric

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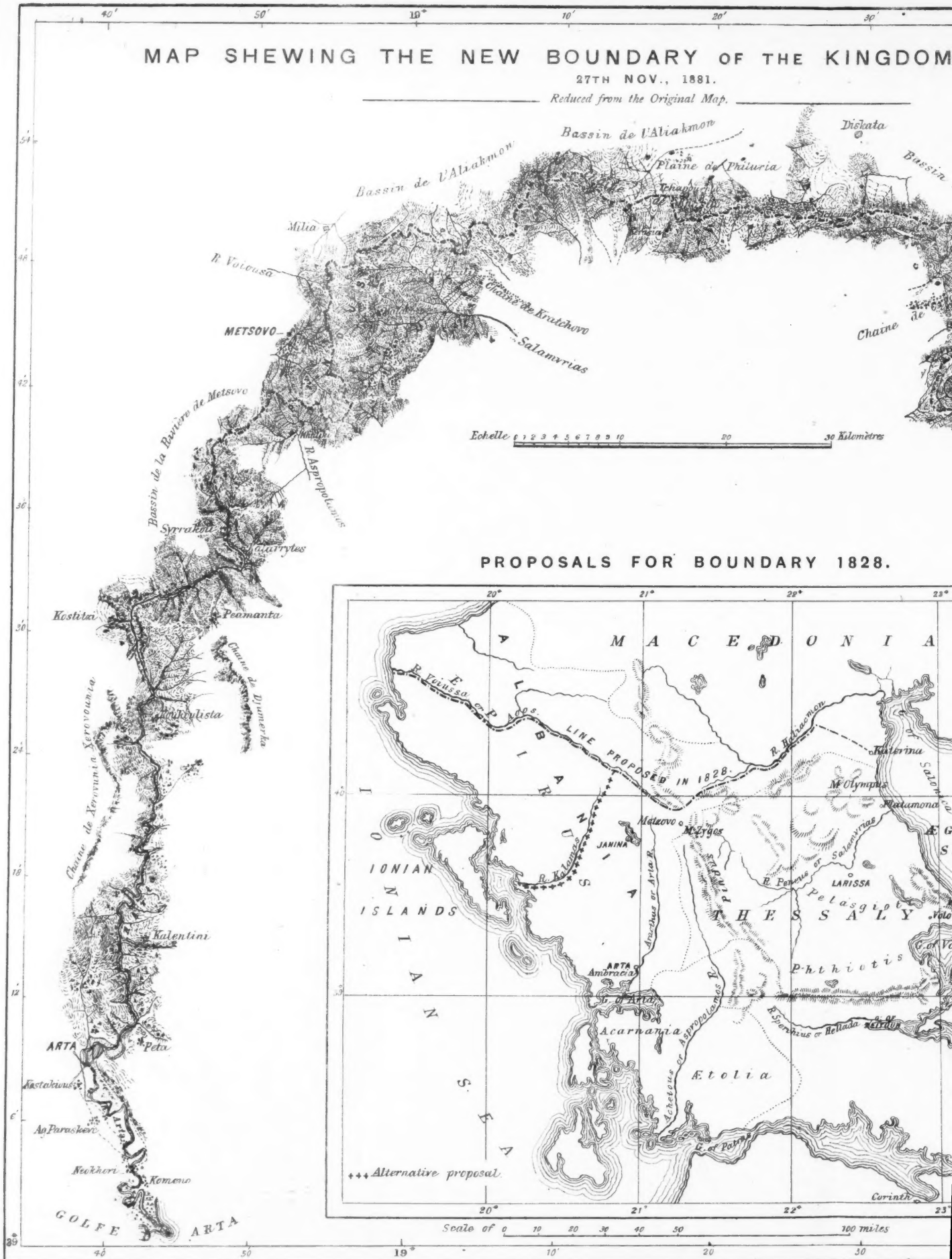
MAP SHEWING THE NEW BOUNDARY OF THE KINGDOM

27TH NOV., 1881.

Reduced from the Original Map.



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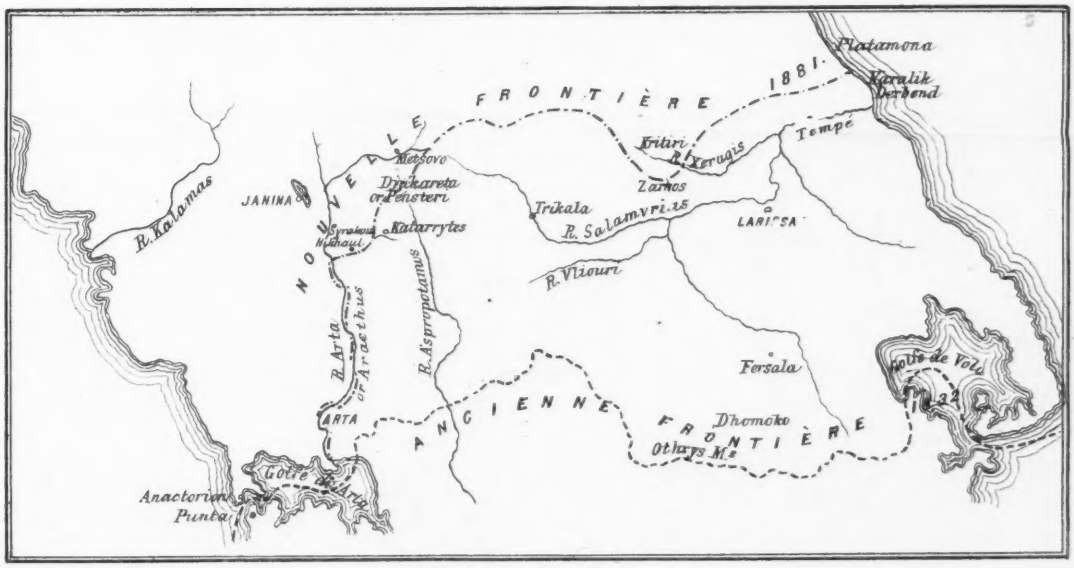
GDOM OF GREECE.

8.

BOUNDARIES OF 1832 AND 1881.



Scale of 0 10 20 30 40 50 100 miles

times. The origin of the Greek race, or rather of the Hellenes, is traced by Apollodorus up to the deluge which Deukalion and Pyrrha survived. Hellen, one of their sons, gives his name to the tribe, in substitution of the name of Greeks, which they previously bore. Deukalion is represented as ruling in Phthiotis, which corresponds to the basin of the ancient Sperchius, now called Hellada, but Aristotle affirms that the district of Hellas lay near Dodona and the Achelous (Aspropotamos), a statement which shows that he could not have visited the country, inasmuch as he would, in that case, have mentioned the Aracthus, whose basin intervenes between the Achelous and Dodona.

Homer represents the Selli, who preceded the Greeks, to have been the ministers of the shrine of Dodona, "men who slept on the ground and never washed their feet." Wherever the name originated, it never was used by the Hellenes in historic times, but was conferred on them by the Romans, much in the same way as we call the Skipetars Albanians, or the inhabitants of Deutschland, Germans.

Hellen had three sons, Dorus, Æolus, and Xuthus. Of their descendants, the Dorians occupied the country on the northern side of the Gulf of Corinth, Ætolia, and Akarnania; the Æolians possessed Thessaly; and the Ionians and Achæans received the Peloponnesus and Attica.

Here then is the origin of the chief subdivisions of the Hellenic race, more or less legendary, and varying somewhat in different accounts, but substantially accepted by the early Hellenic writers. The deluge of Deukalion may be assigned to about 1400 B.C.; the capture of Troy to about 1150 B.C. At the time of the Trojan War there were already Dorians, Achæans, and Pelasgians in Crete; but the great Ionic and Æolic migrations to the isles and to Asia Minor were subsequent to that expedition. About the same time the Thessalians migrated from Thesprotia, in Epirus, into Thessaly, to which they gave their name, in lieu of the previous denomination of Œlis. This Thesprotian people was not indigenous in that locality, but had arrived there in the course of its wanderings, and was of Hellenic origin; for the Thesprotians of the historic period, in common with the other Epirote nations, were designated as barbarians.

The first detailed account of the Hellenic tribes acting in unison is, of course, the narrative of the Trojan War. The force assembled at Aulis (the Strait of Evripo, between that island and the mainland of Bœotia) consisted of 1,186 ships and from 100,000 to 135,000 men. The catalogue of the ships in the Second Book of the "Iliad" comprises the following states or tribes:—

Mykenæ	Agamemnon	100
Arkadia		60
Sparta	Menelaus	60
Pylus (Navarino)	Nestor	90
Krete	Idomeneus	80
Argos	Dromedes	80
Elis		40

Dulichium, Echinades	Meges	40
Etolia	Thoas	40
Ithaka	Ulysses	12
Salamis	Ajax	12
Eubœa	Elphenor	40
Bœotia	Peneleus	50
Orchomenos, Aspledon		30
Locria	Ajax Oileus	40
Phokis		40
Athens	Menestheus	50
Phthia, Hellas	Achilles	50
Phylaké, Pyrasus	Protesilaus	40
Ormenium	Eurypylus	40
Trikka	Podalirius, Machaon	30
Pheræ	Admetus	11
Melibœa	Philoktetes	7
Lapithæ	Polypœtes	40
Ænianes, Perrhæbians	Guneus	22
Magnetes	Prothous	40
Rhodes	Tlepolemus	9
Symé	Nireus	3
Kos and Karpathus	Pheidippus	30
	Total	1,186

In the catalogue of the ships the most northerly tribes mentioned occupy parts of Akarnania and Ætolia, on the Adriatic side, and Trikkala, and Alassona, and Magnesia on the Ægean side.

The next evidence which I shall quote as to the limits of ancient Greece is that afforded by the members of the Amphictyonic assembly, which comprised Thessalians, Bœotians, Dorians, Ionians, Perrhæbians, Magnêtes, Locrians, Œtæans, Achæans, Phocians, Dolopes, Malians, none of which belong to Epirus, to Akarnania, or to Ætolia.

At Thermopylæ (B.C. 480), the forces under Leonidas were drawn from within the late limits of the Greek kingdom under the settlement of 1832.

In the Peloponnesian War (431 to 404 B.C.) Anactorion (near Punta) and Ambracia (Arta) are the most northerly cities engaged, and the Epirote tribes are described as barbarians by Thucydides.

There is abundant testimony afforded by the ancient geographers and travellers as to the limits of Greece.

In the travels of Anacharsis (364 B.C.) Greece is said to comprise Peloponnesus, Attica, Phocia, Bœotia, Thessaly, Akarnania, and several Greek colonies in Epirus, in which he says there are fourteen ancient

nations, most of them barbarians, dispersed in rude towns. Ætolia, he adds, is inhabited by a warlike nation divided into several tribes, in general of Greek origin, though some of them still retain relics of their ancient barbarism by speaking a language very difficult to understand. Greeks then inhabited the Ionian and Ægean Islands, with Cyprus and Crete, the coast of Anatolia, and several districts on the shores of the Propontis (Marmara) and Euxine (Black Sea), as Byzantium, Selymbria, Panticapæum, besides settlements on the coast of Illyria, numerous States in the south of Italy, almost all Sicily, Marseilles, Cyrene, and Naucratis on one of the mouths of the Nile.

Strabo (20 B.C.) says: "On the right of the entrance of the Ambracian Gulf dwell the Akarnanians, a Greek tribe. On the left is Nicopolis and the Kassopæans, an Epirote tribe." (7, 7, 6.) "The tribes extending beyond the Ambracian Gulf to the eastward, and contiguous with the Peloponnesus, are Greek." (7, 7, 4.) "The River Peneus bounds Macedonia towards the north, and Thessaly towards the south. The tribes from the Strymon to the Pontic Straits and the Hæmus are all Thracian, except on the coast, which is inhabited by Greeks." (7, 7, 4.)

Scylax says: "From Ambracia Greece is continuous along the coast as far as the River Peneus." (Periplus, 33.)

Dicæarchus "draws the limits of Hellas at the country of the Magnesians" (*i.e.*, up to the Vale of Tempé).

Scymnus describes the Thesprotians, Chaonians, Molossians, and inhabitants of the interior of Epirus as barbarians (430–460), and says that above Tempé towards Olympus is the region of the Macedonians.

Dionysius Calliphontis states that "Greece is continuous from Ambracia to the Peneus."

Thucydides says that "Amphilochus, the son of Amphiaraus, founded Argos of Amphilochia on the Gulf of Ambracia, immediately after the Trojan War. Many generations after, the inhabitants of the city prevailed upon the Ambraciots bordering upon Amphilochia to unite with them. This community of residence brought them to their present use of one common language, viz., the Greek; but the rest of the Amphilochians are still barbarians;" and further on he mentions as barbarian allies of Cnemus the Lacedemonian, the following Epirote tribes—Chæonians, Thesprotians, Molossians, Antitœnians, Paravæans, and Orestians.

I have gone into some detail in order to show that the limits of ancient Greece were well known, and that all these eminent authorities of antiquity display a remarkable unanimity in describing them. If a comparison be made between their definitions and the line of the new frontier, it will appear that as the main range of Pindus is the boundary between Thessaly and Epirus, the new frontier confers a portion of Epirus on Greece, which certainly was not Hellenic in very early times. On the other hand, Oloosson and the valley of the Titaresius were Greek, at any rate, in the Trojan War, and are now left to Turkey. These slight variations may be considered equivalent,

and therefore we may affirm that the new boundary is virtually coincident with the limits of the country in classic times.

Although enormous changes have swept over the land since the short-lived brilliance of early Hellenic independence, there cannot but be a sincere feeling of satisfaction in the hearts of us all at thus seeing the modern Hellenes installed in the identical seats of those who sailed to Troy, who fell at Thermopylæ, and who conquered at Salamis.

At the accession of Alexander the Great (336 B.C.) the Greek States were virtually incorporated in Macedonia, and with occasional outbursts of independence remained a part of that nation until the fall of the Macedonian Kingdom at Pydna in 168 B.C., when the Roman domination commenced. It is a curious coincidence that this decisive battle, which put an end to ancient Greece, took place exactly two thousand years before the re-establishment of Greek independence in 1832. After the battle of Pydna the Romans devastated Epirus, destroyed seventy cities, and carried off 150,000 souls into slavery. In 146 Corinth was sacked by Mummius, and Greece was transformed into the Roman province of Achæa, ceasing entirely to have a history of its own, and sharing the fortunes of its masters for sixteen centuries, until the Turkish conquest. Under the Roman Empire, Greece long continued to be the seat of intellectual culture and of the arts and sciences. The tranquillity was broken for the first time in the reign of Gallienus, when a Gothic fleet, starting from the Tauric Bosphorus, passed through the Marmara and the Ægean and captured Athens. "We are told that in the sack of Athens the Goths had collected all the libraries, and were on the point of setting fire to this funeral pile of Grecian learning had not one of their chiefs, of more refined policy than his brethren, dissuaded them from the design by the profound observation, that as long as the Greeks were addicted to the study of books, they would never apply themselves to the exercise of arms."

Aurelian, although uniformly successful against the barbarians, withdrew the Roman colonies from Dacia (Roumania) to the southern bank of the Danube, thus concentrating the stock from which the Wallachs of the Balkan Peninsula are sprung (270). The next important epoch is the foundation of Constantinople by Constantine, the first Christian Emperor, in 324.

That the city of Byzantium which preceded it was a Greek settlement, it is hardly necessary to observe; but Byzantium was thrown into the shade by its more important neighbours, Chalcedon (Kadikeui), Nicomedia (Ismid), Nicæa (Isnik), Cyzicus (Artaki), &c.; while the city founded by Constantine rose at once to pre-eminence, and was essentially Roman, Latin, and Christian, the cities of Greece and Asia being despoiled for its adornment. The centre of the forum is still marked by the "burnt pillar;" and the triple brazen serpent offered by the victorious Greeks at the Delphic oracle after the defeat of Xerxes still stands in the middle of the circus. Under the new *régime*, in the department which administered public affairs, there were 148 secretaries, of whom *one* was allowed for the Greek language. I mention these, among a host of evidences, to indicate that the Eastern

Empire was not Greek in its foundation. Julian, "the Apostate," was educated at Athens, and considered the language of the Romans as a foreign dialect. His orations were written in Greek, and it is interesting to observe that in his letters he gives the sun (Ἥλιος) a very eminent place in his theological system, and had, indeed, a domestic chapel to his tutelary deity, a fact which bears on the nomenclature of so many elevated positions throughout the East. Along the line of the new frontier there are several hills bearing the name of Agios Elias, which undoubtedly is a mere corruption of the Pagan name. Julian calls the sun God, and the throne of God.[1]

In Greece, the temples of Minerva were opened by his express command, and there was a general revival of the ancient religion during his short reign, but for the last time (360).

Under Valentinian, the school of Constantinople had an equal number of Latin and Greek grammarians. Latin was the military idiom even of the Eastern Empire (364).

In 388 the question was put to the Senate whether the worship of Jupiter, or of Christ, should be the religion of the Romans, and Jupiter lost by a large majority. A general destruction of the magnificent temples of antiquity followed. The edicts of Theodosius (380) absolutely prohibited Pagan worship; yet so late as 680, the 6th Council of Constantinople forbade "the mysteries made in the names of those who are falsely called gods among the Grecians," and "the invocation of the name of the execrable Bacchus."

The festival of the Lupercalia was certainly celebrated up to the fifth century, during which Christianity was embraced by most of the great barbarian nations. The Goths first crossed the Danube in 249, and after many years of oppression by the Romans, at last revolted in 378, and marched against the Emperor Valens, who was slain in the battle of Adrianople. On the death of Theodosius they again revolted, and advanced southward, under Alaric, into Greece, in 395. A few cities purchased immunity, but the bulk of the male population was put to the sword, the female captives became the prize of the victorious barbarians, and every article of value was carried off. Alaric escaped the attack of Stilico, and retreated through Epirus, ravaging as he went. The western Emperor, Honorius, powerless to oppose him, promoted him to the post of Master-General of Illyricum, in the vain hope of diverting his attention from Rome, which after three sieges was sacked by the Goths in 404. The next barbarian inroad was that of the Huns, under Attila, who penetrated through Thessaly, as far as Thermopylæ, in 449. It was reserved for Justinian to suppress the schools of Athens, which even the Goths had spared (529). The stipends of the professors were devoted to the construction of fortresses along the frontiers of the decaying Empire.

[1] Libanius (the historian of Julian) says: "The sound of prayer and music was heard on the tops of the highest mountains; and the same ox afforded a sacrifice for the gods, and a supper for their joyous votaries." (I have seen something very nearly approaching this on Sunday at Agios Elias of Raphtaneus, July, 1881.)

In 539 began the invasions of the Slav tribes. They spread up to the suburbs of Constantinople and the Ionian Sea, destroyed Potidæa, ravaged Greece, Thrace, and Macedonia, and put all their male prisoners to a cruel death.

Procopius, the historian of Justinian, affirms that each annual inroad of the barbarians cost the Empire 200,000 of its inhabitants.

Connected with this period are the Code, Pandects, and Institutes of Justinian; monumental works of jurisprudence, compiled by his order, at Constantinople, under the supervision of Trebonia, "in a Latin not unworthy of the silver age."

Between the reign of Justinian, 527, and that of Basil the Macedonian, 867, the transition from Latin to Greek as the language of the Eastern Empire was effected.

I venture to attract your particular attention to this fact of language. Under Justinian public business in the Eastern Empire was transacted in Latin; the laws were Latin; Latin was the language of the army until the end of the sixth century (Hertzberg). A Greek writer, who was himself a Roman ambassador, says that, in the middle of the fifth century, the Greek language was unknown in the countries between the Adriatic, Ægean, and Black Seas, and the Danube, except on the coast towns of Thrace and Illyria; and that Latin was the ordinary means of communication among foreign races (Finlay).

In the following three centuries all this was changed. From 586 downwards, all decrees were published in Greek (Hertzberg). Under the successors of Basil the Macedonian, a Greek revision of the jurisprudence of Justinian became the acknowledged code; and in the ninth century Latin became generally extinct as a living language, degenerating, where it continued, into the dialects which subsequently revived into Italian in the west, and Vlach, or Roumanian, in the east.

During this same period that Greek took the place of Latin at Constantinople, another and more remarkable change was being continued in Greece, viz., the ejection of the Greek population by the barbarians. I will not invite you to accept in its entirety the sweeping statement of the learned Professor Fallmerayer, that the Hellenic race was extirpated from Europe; and that not a drop of Greek blood existed in the Morea; but there is unequivocal testimony that the process of substitution reached a comparatively advanced stage. The facts bearing upon it I shall endeavour to place before you in as concise a manner as possible.

The first great invasion of Greece after the establishment of the Roman supremacy was that of the Goths in 269. They came in an enormous flotilla down the Neister, through the Black Sea and the Marmara into the Ægean, laid siege to Salonica, and marched thence across to Illyria, but were defeated at Naissus (the modern Nish), and in the reign of Aurelian settled in Dacia (Roumania), which was evacuated by the Romans (274).

The Goths, being pressed by the Huns, again moved across the Danube into the Eastern Empire, ostensibly as Roman subjects; but,

revolting against their ill-treatment by Roman officers, they marched against the Emperor Valens, whom they defeated and slew in 378.

To them succeeded the Visigoths under Alaric, who, in 395, invaded Thrace and Macedonia, overran Greece, even to the Morea, ransomed Athens, and ravaged the countries they passed through, ultimately moving through Epirus towards Rome. During this invasion a large portion of the population of Greece fled to the islands. The Goths were fanatical Arian Christians, and were urged by their priests to destroy the heathen temples. Among those of ancient renown which they ruined was that of Demeter at Eleusis.

In 493, the Bulgarians crossed the Danube. In the same year, Ostroyllus, a Gothic monarch, occupied Epirus, and styled himself King of Prevalitania. He was defeated by Justinian in 535. In 517 the Bulgarians ravaged Thessaly and Epirus, pushing forward as far as Thermopylæ, and in 540 as far as the Isthmus. To these succeeded various inroads of Avars, Slavonians, and Bulgarians, which penetrated into the Morea, and established themselves there. Curtius maintains that there was an Avar kingdom in the Morea from 589 to 807.

It is certain that Salonica was frequently besieged by these Slavonian invaders from 597 to 681. The holy Wilibald, who made a pilgrimage to Palestine in 723, 728, touching at Monemvasia in the Morea, describes it as *Slavinica terra*—a Slavonian country, which in fact was true at the time of the greater part of the Balkan Peninsula.

In 783, the Empress Irene sent an expedition to reduce the Slavs in Greece, and they yielded, and promised to pay tribute; but in 807 they rebelled, and besieging Patræ, were there repulsed. An endeavour was then made to re-people Greece with Greek-speaking colonies, but nevertheless there was in 849 another Slav insurrection in the Morea, and Bryennius, who was sent to quell it, made a treaty with the Slavonians. A few years later, in 861, took place the conversion of the Bulgarians to Christianity, Cyril and Methodius being the apostles. The Emperor Basil the Macedonian was a Slavonian groom, Hellenised at Constantinople. His origin appears to have had a material influence on the fusion of Greek and Slav, and on the conversion, not only of the Slavonian population of Greece, but also that of the remnant of the ancient Greeks, which still practised the worship of the gods of Olympus in the wild fastnesses of Maina and Taygetus nearly five centuries after the edict of Theodosius. From the reign of Basil dates the protection afforded to the religious communities of Mount Athos. In 924, and again in 929, the Bulgarians swept over Thessaly and Epirus, took Nicopolis, and made it the capital of a new Slav colony. A few years later the Slavs of the Morea again rose against the Empire, endeavoured to assert their independence, but were subdued.

In the reign of their King Samuel (976), the Bulgarians, whose capital was then at Presba, and later at Ochrida, again marched southwards, captured Larissa, colonized Epirus and a part of Albania, and even penetrated into the Peloponnesus. Samuel, after a repulse on the Sperchius, was totally defeated near Salonica, and 15,000

Bulgarians were taken prisoners (1014). These miserable wretches were blinded, one eye being left to each hundred men to guide them on their return.

In 1015 Ochrida was taken, and for a few years the Bulgarians were tranquil.

In 1040 they again rose in Epirus, and about the same time the Norse prince Harald took the Piræus and menaced Athens. The record of his exploit is engraved in Runic characters on the lion which formerly gave the name of Porta Leone to the Piræus, and which was carried thence to Venice in 1688.

The Slavonian domination in Greece for so many centuries left a lasting mark on the topographical nomenclature of the country. The contemporary geography of Constantine Porphyrogenitus gives a very extensive catalogue of names, chiefly of Slav origin, which had supplanted the ancient and well-known Greek local epithets, and which indeed still continue to hold their own, in spite of the recent endeavours to revert to classic nomenclature. Professor Kiepert says, that of the names in Greece and Thessaly, with the exception of the islands, three-fourths are Slav, one-tenth Albanian, and one-tenth modern Greek. I can hardly say that this is entirely borne out by my own observation.

In 1081 the Normans, under Robert Guiscard, took Durazzo (Dyrrachium). His son Bœmond subdued Epirus, defeated the Emperor Alexius at Janina, and again near Arta; and marched into Thessaly and Macedonia. Trikkala was taken, but Larissa, after holding out for six months, was relieved by Alexius, who appeared with a fresh body of troops, comprising 7,000 Turks. The Normans, in 1084, were defeated and retired to Avlona. In 1146 the Sicilian Normans took Athens, Thebes, and Corinth, and in 1185, after capturing Durazzo, they laid siege to Salonica, and advanced towards Constantinople, but were defeated at Demetritza (Amphipolis), between Gumurdjina and the Maritza. They still, however, held the Ionian Islands and Durazzo in 1186, after which year little more is heard of them.

I have already stated that, in the fifth century Latin was the language of the Balkan Peninsula, and I will now call your attention to the fate of the Latin-speaking people. Those settled in Dacia by Trajan had been withdrawn south of the Danube by Aurelian in 274, and continued to occupy the principality of Bulgaria concurrently with the Bulgarians, during many centuries as a Vlacho-Bulgarian Kingdom.

In the south, the Latin element was still stronger. Roman colonies were transported into Epirus to replace the 150,000 inhabitants enslaved by Paulus Emilius. Again, in the reign of Augustus, when Nicopolis was founded, an extensive Latin immigration took place. During the frequent invasions by the barbarians, these Latin-speaking peoples appear to have found a refuge in the more inaccessible parts of the country, and there to have remained. Anna Comnena, the biographer of her father the Emperor Alexius, speaks of levies

collected from "those who lead a nomad life, called Vlachs in the common dialect." She also mentions Vlach villages in Thessaly (Alexius, v, 5), and speaks of the Komani, a Slavonian tribe with whom the Emperor was at war, being shown other passes of Zygos by the Vlachs; and in reference to the garrison of the Chortarea Pass, she mentions Pudilus, a person of eminence among the Vlachs (Alexius, x, 2), evidently implying that the whole district was Vlach.

The Rabbi Benjamin of Tudela, who made an inquisition into the state of the Jews in the East in 1170, writes at Sinon Potmo, which appears to be Zeitoun or Lamia (the excellent Rabbi's own names are phonetic, and in Dr. Gerran's translation are rendered phonetically into English): "This is the beginning of Wallachia, the inhabitants of which dwell in the mountains, and are called after their country—Wallachians. They are as swift as mountain goats, and make frequent inroads upon the Javanitish territory for spoil and plunder. None are able to contend with them in war, nor can any king subdue them. They observe not the religion of the Nazarenes, and give themselves Jewish names; from whence, some assert that they are Jews, that they call the Jews their brethren; and that when they meet with any of our people, they rob but never kill them. Upon the whole they are a set of lawless people."

Thessaly was in fact, at this period, and for long after, called Greater Wallachia; and Ætolia and Akarnania, Lesser Wallachia.

In a commercial treaty between the Emperor Alexius III and the Venetians, in 1199, Greater Wallachia is mentioned in connection with the towns on the Ægean coast near the Gulf of Volo.

Nicetas compliments the Vlachs by stating that they were able to defend themselves against the Crusaders, which was more than the Byzantine Empire could do.

In the 13th century, the Northern Vlachs recrossed the Danube to reoccupy the seats abandoned by their progenitors a thousand years before, and there established a new Wallachia. They all called themselves Roumouni or Romans, and they do so to this day, both in north and south, and continue to speak a language which more nearly resembles Latin than even Italian.

The Southern Roumanians, or Vlachs, are still to be found in the countries where they were met with by Benjamin and the other chroniclers, and in many respects are, as Anna Comnena describes them, nomads. Their chief occupations are those of carriers and shepherds. All our baggage and riding mules were hired from Vlachs, who have almost a monopoly of the carrying trade in Thessaly and Epirus; and in all the grazing districts most of the shepherds were Vlach.

The Crusades.

In the 11th century, the Turks already menaced the Eastern Empire. The Seljukian kingdom extended to the shores of the Bosphorus, and the Emperor Alexius appealed to the west for assistance; holding forth as incentives to religious zeal, the wealth of

the east, the delicious flavour of its wines, and the beauty of the Grecian women.

The Koran then reigned from the Pyrenees to the mouths of the Ganges, while the Gospel was limited to Europe, with the exception of Spain. At the holy shrines of Jerusalem, the Turks extended no longer to pilgrims that tolerance which was displayed by the early Kaliphs. A pious enthusiasm inspired the faithful to rescue the tomb of their Saviour from the hands of the infidel; and after the Council of Clermont (1095) more than a million engaged themselves to support the holy enterprise. The First Crusade set out; a horde of savage adventurers, who ravaged Europe on their way to Constantinople, where Alexius made all haste to relieve himself of their presence by transporting them into Asia Minor, where the advanced guard was speedily massacred by the Turks at Nicæa. By force of numbers, however, they overran Asia Minor, took Antioch, and at last Jerusalem itself (1099)—destined to be retaken in 1187.

The First Crusade was so far advantageous to the tottering Empire, that it temporarily drove back the wave of Moslem conquest in Anatolia; but the remedy was destined to be more immediately fatal to the Greek Empire than the disease itself.

A Frank domination of a feudal character was established in the Holy Land. Godfrey de Bouillon became King of Jerusalem; Edessa and Antioch were erected into principalities. There was a Count of Tripoli, a Marquis of Tyre, and Lords of Nablouse, Jaffa, Ramleh, and Tiberias. This singular mixture of Biblical names and feudal institutions displays the true character of the Middle Ages—the intimate union between religious faith and military life.

The connection between these Eastern settlements and Western Europe was maintained by a variable stream of pilgrims, swelling chronically, according to the exigencies of the occasion, to the dimensions of a Crusade.

Already in 1054 the final rupture between the Greek and Latin Churches had been solemnized by the legates of the Pope, who deposited on the altar of Santa Sofia an anathema condemning the seven mortal heresies of the Greeks. The breach was widened by the conduct of the Greeks during the Second and Third Crusades. The ardent Latins found the Eastern Christians wanting in zeal for the holy cause. The lawless adventurers who followed the banner of the Cross more from the hope of plunder than any sentiment of religion had seen and coveted the wealth and splendour of the Eastern capital. Their cupidity was aroused by that treasury which had been accumulating for centuries all that was valuable or lovely in the ancient world. Constantinople had not yet been sacked. It had suffered but slightly in dynastic revolutions, while Rome had already for centuries been ravaged by successive inroads of barbarians.

The presence of a usurper on the imperial throne afforded the pretext for directing the Fourth Crusade against Constantinople itself. After a brave defence, it was captured by the Latins (1204). Then followed a scene of horror rarely surpassed in the sanguinary annals of the world. The victorious Crusaders set fire to the city, and in the

light of a vast and awful conflagration entered upon their fiendish work of plunder, lust, and blood. These followers of the Cross, who had bound themselves by oaths not to shed the blood of a Christian, revelled in the abominations practised upon the wretched Byzantines. "God wills it!" the war-cry of the Crusaders, was fervently shouted by 20,000 pious brigands. The city was devoted to ruin. Those of its opulent citizens who escaped with life, after having seen their houses plundered, their wives dishonoured, and their children reduced to slavery, were driven forth in poverty beyond the walls. Every insult was heaped by the Catholic victors upon the churches and ceremonies of the Greek faith.

After these horrors had continued for several days, the Latin leaders proceeded to divide their enormous booty, and to partition the Byzantine Empire.

Baldwin, Count of Flanders, became Emperor of Constantinople and the adjacent parts of Thrace. Boniface, Marquis of Montferrat, ruled over Macedonia, with the title of King of Thessalonica. Two members of the Imperial family of Comneni succeeded in establishing themselves as independent sovereigns—Michael Comnenus as Despot of Epirus, and Alexis Comnenus as Emperor of Trebizond. Theodore Lascaris established a rival Empire at Nicæa; a Dukedom of Athens, under various Frank nationalities, lasted until the Turkish conquest; the Peloponnesus was converted into the Frank principality of Achaia, which subsequently lapsed again to the Byzantines.

It is worthy of remark that the Slavonians in Greece during these changes were sufficiently powerful to live apart under their own laws, and that in Thessaly a Vlach principality was established under John Dukas, a natural son of Michael II, Despot of Epirus; and at a later period a Venetian duchy ruled the Archipelago until as late as 1566.

This dissolution of the Eastern Empire by the Latins was more destructive to the ancient civilization than the subsequent conquest by the Turks. A partial consolidation of the fragments was effected by Michael Paleologus, with the aid of the Genoese, in 1261; but a more wretched, shameful history than that of the restored Greek Empire, until its final overthrow by the Turks, does not disgrace the annals of mankind.

Othman, the Turkoman chief, whose name is now applied to the whole Turkish Empire, established the seat of the Ottoman power at Brusa in the beginning of the fourteenth century. His successor, Orchan, though content with the title of Emir or Prince, was sufficiently powerful to espouse Theodora, the daughter of the Emperor Cantacuzene. His son, Amurath, crossed into Europe, established his capital at Adrianople (1360), subdued the Sclavonian nations between the Danube and the Adriatic, and was assassinated after the Battle of Kossova, where the last blow was given to the Servian kingdom (1389).

Tirnovo, the capital of Bulgaria, was taken by the Sultan Bayezid in 1393. From that date until recent times the Bulgarian Church had no separate existence. Three years afterwards the united efforts of the German, Magyar, Vlach, and Frankish forces were defeated at Nicopolis on the Danube. Bayezid, who had accepted the patent of

Sultan from the Egyptian Caliph, then turned his attention to Thessaly, where, in 1397, he established feudal holdings known as "timars," penetrated into the Morea, and took Argos. It is from this epoch that the Turkish settlements of the plain of Larissa date. These colonists took the name of Koniarid from the district of Iconium, whence they came. A large settlement of them exists farther north in the district east of Kastoria. They have always been reputed to be a quiet, inoffensive people, who lived at peace with their Christian neighbours.

Even Constantinople itself was blockaded by Bayezid for seven years, and its fall was only postponed by the subjugation of Bayezid by the celebrated Timour on the plains of Ancyra (1402). In the confusion which reigned after the death of Timour (1405), the sons of Bayezid disputed his inheritance, which ultimately was acquired by Mahomet I. His son, Amurath II, again carried his arms into Europe, took Salonica (1430), received the submission of Janina, but subsequently sacked that city, and extended his Albanian conquests over Berat, Castoria, and Croia. Another effort was made by the Christians under Hunyadi, the White Knight of Wallachia, to drive back the tide of Ottoman conquest, but after some transient successes, they were completely routed at Varna. Amurath now subdued the Morea (1446), and again entered Albania, which had been roused to resistance by George Castriotis, who had long been serving in the Turkish Army as a hostage under the name of Iskander Bey.

After defeating another Christian invasion under Hunyadi on the same battle-field that the first Amurath had perished upon, he died in 1451, and was succeeded by Mahomet II, who came to the throne with the determination to take Constantinople.

Religious enmity divided the Greeks. The Emperor was in communion with the Church of Rome, while his Ministers acknowledged the Greek rite. But 7,000 men, including 2,000 Venetians and Genoese, formed the garrison of the city, while Mahomet encompassed it with no less than 260,000.

On the 30th May, 1453, Constantinople was taken, Constantine, the last of the Eastern Emperors, perishing in its defence.

The city was sacked, its remaining wealth was plundered. Vast multitudes of its wretched inhabitants, after suffering every outrage that the cruelty of their captors could inflict, were chained together in droves, and driven to a distant and hopeless slavery. When the Turks departed, they left behind them a depopulated empty city; but soon returned to make it the seat of their own Empire.

The Greek Empire disappeared from history, though the Frank Princes of the Morea and the islands had yet some little respite.

Demetrius and Thomas, the two surviving brothers of the name of Paleologus, ruled in the Morea, which was devastated by their rivalries, as well as by tribes of Albanian robbers. Mahomet marched to the Morea in 1460, ostensibly as the friend of Demetrius, whom he displaced, assigning him a residence in Thrace. Manuel, the son of Thomas, was afterwards hospitably received at Constantinople, where he ended his days.

I have now brought the history of the Greek people up to the point where they disappear again as an independent nationality, and I shall proceed to trace—as concisely as possible, and necessarily in the merest outline—their condition under Ottoman domination for three and three-quarter centuries.

It must not be supposed that when Mahomet II obtained possession of Constantinople he thereby became the ruler of all the remnants of the Byzantine Empire. Most of the islands of the Ægean continued for a considerable period to be ruled by Italian Princes.

The Knights of St. John had their seat at Rhodes, and there withstood all attacks of the Turks until 1522, when, after an honourable capitulation, they withdrew to Malta. Cyprus, which had existed as a kingdom under the Lusignans from 1195, was ceded by Katerina Cornara to the Venetians in 1489, and was not yielded to the Turks until 1573, when they gained their point, notwithstanding the crushing naval defeat at Lepanto.

Candia, which had been overrun by the Saracens in 823, and subsequently recovered, was allotted, on the partition of the Empire by the Latins, to the Marquis of Montferrat, and by him sold to the Venetians.

The Officers of the great Republic exercised the most shameful cruelties upon their Cretan subjects, who almost received with thankfulness a change to the rule of the Turks, when the fortress of Candia fell in 1669, after a siege of twenty years—the longest which history records. The Venetians, however, continued to hold many points on the shores of the Adriatic and in the interior of Albania. Even after the collapse which followed the death of Scanderbeg, the Miridites and Chimariotes maintained an independence which has descended to our own times.

From the Greeks themselves there was absolutely no resistance to the Turkish rule when once established.

Strange though it may appear, the condition and future prospects of the Greeks seems to have been improved by the Turkish conquest. I do not assert that all the Christian nations in the Ottoman dominions profited by the change; but it was most unquestionably advantageous to the Greeks, who, had it not been for the protection afforded to them by the Sultans, would have remained in the degradation to which they had sunk in the latter years of the Byzantine Empire.

The Turks classified their new conquests into the Roman province, *Roumelia;* the country of the Bulgarians, *Bulgaristan;* and the country of the Greeks, *Yunanistan.* The latter name—derived from Ionia, where the first Turkomans had come in contact with the Hellenic race—applies rather to the Anatolian and Insular Greeks, and to the inhabitants of the Morea, than to the other subjects of the Byzantine Empire, who still continued to call themselves Romans. Bulgaristan had been incorporated fifty years before the conquest of Constantinople, and the Morea was subdued a few years after that event, in 1460.

The last Latin Duke of Athens was hung by the Turks.

To the Turks, all Orthodox Christians alike in their new conquests

were known as the Roman people (*Roum Milleti*). The Sultan appointed the Greek Patriarch of Constantinople to be his acknowledged agent for the government of his Christian subjects, and invested him with almost absolute control over the administrative, judicial, and executive affairs of all who adhered to the Orthodox Church. The administration of justice, the continuance of the civil code which had hitherto been in use, the adjustment of the incidence of tribute and taxation, were all committed to the charge of the Greek hierarchy. The germs of national organization, of municipal institutions, and even of freedom itself were contained in this system. An *imperium in imperio* was created.

The Greek hierarchy, by the policy of the conqueror, obtained a supremacy, not only over the Orthodox Greeks, but also over all Bulgarians, Servians, Wallachs, and Albanians who professed the creed; a supremacy which lasted for some centuries, and which, had it been equitably administered, might still have been in existence. Corruption, however, was rampant. The Patriarch purchased his appointment from the Sultan, and recouped himself by the sale of the bishoprics. Simony became universal. During the two centuries which succeeded the Turkish conquest these concessions procured the complete subserviency of the Greeks at Constantinople, who formed a great and corrupt ecclesiastical corporation, with a vast Christian democracy under its rule.

So impressed was the traveller Macarius with the happy state of the Orthodox under Ottoman rule in 1659, that he fervently exclaims —"God perpetuate the Empire of the Turks for ever and ever."

This peculiar system of administration adopted by the early Sultans not only gave to the Greeks considerable power in the general government of the country, but it also endowed them with a preponderating influence over all the other Christian nationalities—an influence so wide that its consequences are still felt. Devotion to the national Church is still a marked characteristic of the Greeks outside Greece, and the Phil-Hellenes claim as Greeks all Orthodox Christians in communion with dioceses depending on the Patriarch of Constantinople. The Bulgarian Patriarchate of Tirnovo was suppressed at the instance of the Phanariote Greeks in 1767, and it was not until 1870 that the Bulgarian Church obtained a firman of spiritual emancipation. Even as late as a few months before the Congress of Berlin, 1878, Greek statistics were published purporting to prove that the whole country south of the Balkans was Greek. How completely untrue these statements were as regards the province of Eastern Roumelia, is notorious. In Macedonia, where many Bulgarian dioceses still depend on the Patriarch, an ingenious theory was devised by which it was maintained that the Bulgarian-speaking inhabitants were really Greeks, but did not know it. The Vlachs likewise are represented in the Greek statistics as Greek; a statement against which they energetically protest, as do likewise the Orthodox Albanians.

With reference to what I have just said, I will relate to you an anecdote of a circumstance which made some impression on my mind.

I was in doubt as to the nationality of a villager, and put to him the usual question, "What is your nation?" (*Né milletsiniz?*) Knowing that he must be either a Bulgarian or a Servian, I was immensely surprised at his saying that he was a Greek (*Roumi*); which was true, in so far as his religion was concerned, and his subjection to the Greek Patriarch; but the man was in fact a Bulgarian, and could not even speak Greek.

Since then I have frequently from curiosity addressed the same question to persons who were obviously not Greek, and have very often received the same reply, showing how very strong is the force of habit. Even Albanians have fallen into the error.

The origin of the ambiguity is very simple. The Roman nation, subdued by the Turks, was Christian in all its subordinate nationalities, and over these Christians the Greek Patriarch had sway. In later times other creeds obtained *berats* or *firmans*, constituting them into "nations;" and the word has thus become synonymous with religion, rather than race.

The Ottoman Empire, with all its anomalies, defects, and abuses, continued to be for two centuries after the conquest of Constantinople a well-ordered and prosperous State; not merely in contrast to the wretched tyrannies it had succeeded, but even when compared with most of the nations of Christian Europe. Many offices of power and emolument were held by the Greeks, of whom large numbers embraced the faith of Islam, and rose to positions of great eminence in the State.

Von Hammer says (VIII, 421), that of forty-eight Grand Viziers who succeeded to power after the conquest of Constantinople, twelve only were native Turks. So great was the inclination of the Greeks to adopt Mahometanism, that the Sultans became alarmed lest they should have no tribute-paying peoples at all, and accordingly began to treat the subject Christians with greater kindness.

The tribute of Christian children, whence the Janissaries were recruited, ceased about 1680.

A clique of influential Greek families, known as Fanariote, from the quarter of Stamboul in which they resided, obtained a monopoly of most of the lucrative posts in the Empire, which could be held by Christians, and have indeed preserved it to this day, notwithstanding the breach occasioned by the Greek revolution.

During the long period from the Turkish conquest until the rise of Russia, Constantinople continued to be the centre from which the Greeks were governed, and the focus of their national life. As for Greece itself, little was heard of it. The Slav nationalities in the Morea, partly Hellenized, partly turned Mahometan, dragged on an uneventful existence. In 1684, the Venetians invaded the Morea, and attacked Athens. It was during this war that the Parthenon was destroyed by the explosion of a mass of powder stored there by the Turks, ignited by a Venetian shell.

By the peace of Carlowitz, 1699, the Morea was ceded to the Venetians. In abandoning it, the Turks carried off everything that was portable, and left the country ruined. Its population, then

estimated at only 100,000, increased again under the Venetians; but in 1715 it was recaptured by the Turks under Ali Koumourgi. During these changes the Greeks appear to have been passive instruments in the hands of both parties, being largely employed by both sides at sea; as for instance in the battle of Lepanto.

It was not until the reign of the Empress Anne that the idea of utilising the Greeks against the Turks was put into practice by Russia. Count Münnich is credited with having suggested to the Empress the policy of stirring up the Greek Christians against their Turkish masters.

The theoretical Phil-Hellenism of Voltaire appears also to have evoked in her a sentimental interest for the Greeks. In 1764, the Greeks in the Morea were encouraged by the hope of Russian assistance, and in 1770, a small force of Russians landed, but met with little response from the inhabitants, among whom they had some difficulty in raising 3,000 men. The insurrection was defeated by a force of Albanians, who subsequently possessed themselves of the country, and tyrannized over it until 1779, when they were exterminated by Hassan Pasha. During this period, privateers under the Russian flag, chiefly Greek, but partly English, perpetrated acts of abominable cruelty in the Greek seas. This piratical fleet was ultimately destroyed by the Turks at Porto Quaglio in 1792. Under the Treaty of Kainardji, 1774, Russia claimed the right of protecting all Orthodox Christians in Turkey, and hence arose a feeling among both Greeks as well as Slavonians, that it was to Russia that they should look for aid in their emancipation.

Accident precipitated a catastrophe. The strange career of the well-known Ali Pasha of Janina; his rise to power by treachery, violence, and corruption; his adroit intrigues, now with the English, now with the French; his wars with the Suliotes; his resistance to the Sultan; his independent and tyrannical administration of Albania, and the long siege he withstood in Janina before his death, are themes which have often been recounted. The conduct of this ambitious and unscrupulous satrap had no slight influence on the development of Greek aspirations; although the nature of the influence is often misunderstood.

Ali Pasha, in the days of his power, suppressed the *Armatoli*, or armed gendarmerie, which had existed as a sort of Christian local militia for the maintenance of internal security, even in the days of the Byzantine Empire, and which had afforded some degree of protection to the inhabitants against the Saracens, the Franks, and others. The *Armatoli* had been recognized by the Ottoman Empire, but the institution was uncongenial with Ali's tyrannical and extortionate government. Upon their disbandment as official guardians of the public security, they reappear as *Klephts*, or patriotic brigands, literally robbers. When Ali was at war with the Porte, many of these *Armatoli* or *Klephts* even joined the Sultan's forces against him; but after expelling the Albanians from their districts, they evinced a disinclination to act further, except for their own interests. Ali, as long as his rebellion was successful, received the support of all those dis-

affected to the Sultan's rule, including even his ancient enemies, the Suliotes, who went over to him during the siege of Janina. The disaffection in Greece, which had been fermenting ever since the Treaty of Kutchuk Kainardji, was stirred up by the French revolution; by the substitution of French for Venetian rule on the Adriatic by the Treaty of Campo Formio, 1797; and by the various changes which took place between that period and the Congress of Vienna. In the Danubian Principalities, too, the cause of Greek independence took root under the auspices of the *Etairia*, or patriotic society.

In 1821, when Kurshid Pasha was ordered from the Morea to take charge of the operations against Janina, the whole population of the Peloponnesus rose against the Turks.

In the month of April of that year, a Mussulman population, generally of indigenous race, amounting to upwards of 20,000 souls, was living dispersed in Greece employed in agriculture. Before two months had elapsed, the greater part was slain. Men, women, and children were murdered on their own hearths without mercy or remorse. At the same time small bodies of Turks in the Danubian provinces were massacred by the Etairia.

The Turks were aroused to exact a sanguinary revenge. Gregorius, the Patriarch of Constantinople, a venerable man of ninety years, was hung at the door of his own church in his pontifical robes. There can be little doubt of his complicity with the insurrection, but the circumstances of his execution will for ever leave a stigma on the Turks. In three months the blood of 30,000 Greeks had consecrated the opening of their struggle for freedom.

Upon the first outbreak, the Greeks of Agrapha, the mountainous district between Thessaly and Epirus, and those of the great mountains Pelion, Ossa, Olympus, and Pindus, took up arms, as did the inhabitants of the Chalcidic Peninsula. But being immediately subdued, they remained peaceful subjects of the Sultan during the whole of the War of Independence, and at its close refused to avail themselves of the liberty to become Greek subjects.

I will pass over the sanguinary atrocities which characterized the War of Independence, merely observing that its most conspicuous characters (on the Greek side) were chiefly of Albanian origin. In 1825, Ibrahim Pasha came to the aid of the Turks with a fleet carrying 15,000 Egyptians. He overran the Morea, and the cause of Greek independence, coldly regarded by the Governments of Europe, was at its lowest ebb.

England, France, and Russia, however, signed a treaty on the 6th July, 1827, pledging themselves to an immediate and effective interference, for the purpose of putting an end to the war in Greece. The Turks rejected the proposed mediation. Ibrahim continued his ravages, and returned unopened a note from the Allied Admirals. The Turco-Egyptian fleet was attacked and annihilated at Navarino on the 20th October, 1827.

This destruction of the naval power of Turkey—described as an *untoward event* in the King's speech of the following session—was

followed by the Ambassadors of England, France, and Russia quitting Constantinople upon the refusal of the Porte to admit of intervention in the Greek question. In April, 1828, Russia declared war against Turkey. In August, Ibrahim withdrew the Egyptian troops, and in October a French force occupied the Morea. The struggle was at an end.

A Conference, composed of Representatives of England, France, and Russia, met at Poros in 1828, to discuss the Greek question. They were, *inter alia*, instructed to answer, "What boundary line would suit Greece best, giving her a continental frontier clearly defined, easily defensible, and which would best separate the populations?"

The Greeks claimed a line commencing at Katerina, a little to the north of Platamona, crossing from thence to the Haliacmon, which it followed up to Mount Pindus, to the north of Metsovo; and from thence following the River Voiussa or Aoos.

In case this proposition was rejected, they asked for a line including Janina and then following the Kalamas.

The Conference thought that the line from Pindus to Olympus would meet with the required conditions; but considered, "that, as the inhabitants of Epirus and Thessaly took little or no part in the wars of the Revolution, and, as many of the Chiefs were in the service of the Porte, it would be contrary to the letter and spirit of their instructions to comprise these two provinces in the new State."

An alternative line was also proposed by the Greeks, commencing near Mount Pelion, including Volo and a part of Southern Thessaly, on the side of the Ægean, and following the southern watershed of the basin of the Kalamas on the side of the Ionian Sea.

The Conference, however, objected to depriving Thessaly, without any real advantage to Greece, of the Gulf of Volo, the principal and necessary outlet for the productions of that province; and it ultimately recommended a line from the Gulf of Volo to that of Arta; but on its being presented to the Sultan on the 22nd March, 1829 (the Russian Army not yet having crossed the Balkans), he refused to accept it. Upon the submission of the Porte in the Treaty of Adrianople, which would have obtained for Russia the entire merit of the settlement, France and England represented that the solution did not rest with her alone, and a new Conference was held, at which it was agreed that Greece, instead of being an autonomous tributary dependency, as had been hitherto proposed, should be completely independent; but a less liberal line of frontier was suggested, from the mouth of the Aspropotamos to the Gulf of Zeitoun.

The Throne of Greece was offered to Prince Leopold of Saxe-Coburg, who requested an extension of the continental frontier and the addition of Candia and Samos; and upon the refusal of the proposition declined the Crown.

The Greeks now recommenced fighting among themselves. Capo d'Istrias was assassinated; anarchy supervened, and lasted until 1832, when Prince Otho of Bavaria was named King of Greece, and a definitive settlement of the Greek question was arrived at by what was known as the Arrangement of 1832.

With the exception of internal disorders, brigandage, and occasional revolutions, the new kingdom existed without the interference of the Powers until 1853, when the war between Russia and Turkey emboldened the Greeks to invade Thessaly, and hostilities were only put an end to by the occupation of the Piræus by English and French troops.

In 1863 King Otho was ejected, and Prince Alfred was invited to accept the Throne, a proposal incompatible with the Treaty stipulations between the three Powers. The choice finally fell on the present Sovereign, who ascended the Throne on the 31st October, 1863, bringing with him the Ionian Islands as a dower.

In 1877, as soon as the success of the Russian arms in Turkey was assured, the Greeks seized the opportunity and invaded Thessaly with a force of 15,000 men, and 60 or 70 guns; and organized insurrections in that province, in Epirus, and in Crete. These movements were, notwithstanding her great straits, successfully opposed by Turkey; but at the conclusion of the war, the Porte was informed by the Powers that it could not be allowed to exercise a pressure upon Greece, by employing its fleet for a movement on Athens.

The Treaty of San Stefano completely subordinated the interests of the Greeks in Turkey to those of the Slavonian races, and excited among them a well-founded alarm. Their interests, however, were not lost sight of in the revision of that Treaty at the Congress of Berlin; which, in its 13th Protocol, "invites the Sublime Porte to come to an agreement with Greece for a rectification of the frontiers in Thessaly and Epirus, and is of opinion that this rectification might follow the valley of the Salamvrias (ancient Peneus) on the side of the Ægean; and that of the Kalamas on the side of the Ionian Sea."

The Greek Government thereupon named Commissioners to discuss the rectification, with others to be appointed by the Porte; but their first meeting did not take place until February, 1879. The modifications proposed by the Porte being in no way conformable to the indications of the Protocol, the negotiations were broken off, to be again ineffectually renewed in the autumn. Meanwhile both sides were arming, and Thessaly and Epirus were overrun with bands of brigands.

The negotiations between the Porte and Greece failed to settle the question, and the Powers, after mature consideration, determined to exercise the right of mediation which they reserved to themselves by the 24th Protocol of the Treaty of Berlin. A Conference took place at Berlin in 1880, and a line of frontier proposed by the French Representative was unanimously adopted.

This line ascended the Kalamas to its source, and thence followed a watershed, leaving the basins of the Arta, Aspropotamos, and Salamvrias to Greece. The award was communicated by the Powers to Turkey and Greece. The Porte replied by a note, in which it argued that the cession of Janina, which was regarded by the Albanians as the capital of Lower Albania, and that of Larissa, three-fourths of whose inhabitants were Mahometans, could not be consented to; and

it requested that negotiations might be entered into by the Representatives of the Powers.

The French Government, which had hitherto taken the lead in pressing the matter forward, now began to hold back. A collective note to the Porte was, however, presented in August, 1880, in which the Powers declined to reopen the question. The Sultan, however, was obstinate, and the pressure hitherto exercised by the Powers upon Greece to abstain from arming was withdrawn.

During the autumn of 1880 the Greek Army was mobilized, and the Turkish forces in Thessaly and Epirus were raised to a war footing. An outbreak of hostilities was imminent. Negotiations with the Porte were recommenced, but the situation continued to be exceedingly critical. The cession of Crete was proposed as a compensation for a diminution of the award of the Conference Line, but after frequent discussion was abandoned. In March, 1881, the Porte made an offer, which has virtually formed the basis of the present settlement. England appeared to be the only Power still desirous of endeavouring to obtain better terms for the Greeks. All the others were ready to accept this last proposal of the Porte; England yielded to the majority, and on the 6th April the Greek Government was invited to acquiesce in the proposed settlement. A Conference thereupon assembled at Constantinople, and on the 24th May, 1881, a Convention was signed by the Representatives of the Porte and the Powers, laying down the line of new frontier, specifying the manner in which the ceded territory was to be evacuated, and providing safeguards for personal, proprietary, and religious interests.

I have already noticed that the frontier thus awarded coincides, with singular exactitude, with the limits of Ancient Greece. Though it falls short of the line of the Berlin Conference, it must be observed that a considerable portion of the Epirote territory between the Kalamas and Prevesa is Mahometan in religion, and Albanian in language and sympathies. It is, indeed, a question, whether the incorporation of that population in Greece would not rather have been a loss than a gain. Throughout these long and critical negotiations the equitable claims of the Greeks have received the steady and unswerving support of Her Majesty's Government; and without it, there is much reason to believe that this solution might not have been arrived at.

It is not altogether surprising that the Greeks should feel somewhat aggrieved that the hopes founded upon the award at Berlin should not have been realized; but I will venture to point out that it must now be admitted, that in view of the determined attitude assumed by the Porte, and the aversion of the Powers to active measures, they could only have been attained by a successful war. What the result of a war between Turkey and Greece might have been, I will not presume to speculate upon. Such a war would undoubtedly have entailed very great sacrifices upon both countries, and possibly might have led to further complications. That it has been averted, is a matter of general congratulation.

The area of the new accession to the Greek kingdom is about

5,200 square statute miles, or about two-thirds of the extent comprised in the award of the Conference of Berlin, viz., 7,883 miles. In comparison with the superficies of the Greek kingdom, as settled by the arrangement of 1832, it amounts to nearly one-third of the whole, or to two-thirds of the area of either the Morea or of the mainland.

The most striking comparison, however, is the fact that the gain of Greece by this settlement is very nearly equal to the territory of Alsace and Lorraine, ceded to Germany after the war of 1870–71. The Kingdom of Saxony, the Grand Duchy of Baden, and the Duchies of Schleswig-Holstein, are also nearly equal in area to the provinces in question. Nearer home we may find an approximate equivalent in the south-east portion of England between the south coast and the Thames, comprising Kent, Surrey, Sussex, and Hampshire.

In general terms the new frontier follows the course of the River Arta, the ancient Aracthus, from its mouth to a point nearly south-east of Janina, and thence follows a tributary stream to the highest point of Pindus, Mount Djukarela, or Peristeri. From thence it follows the main watershed of Mount Pindus, leaving the basins of the Arta and Voiussa on the west, and those of the Aspropotamos and the Salamvrias on the east. Upon leaving Pindus it follows the water-parting between the basins of the Salamvrias and the Haliakmon, and subsequently between the Salamvrias and its tributary the Xeraghis, which it crosses near its junction with the main stream; and thence ascending to the crest of the range of Lower Olympus, follows it to the Ægean coast, which it strikes between the mouth of the Salamvrias and the fort of Platamona.

This new frontier was fixed on the ground by a Commission, upon which each of the mediating Powers, as well as the interested States, were represented.

I had the honour to be Her Majesty's Commissioner, and had the valuable assistance of Captain de Wolski and Lieutenant Leverson, both Officers of the Royal Engineers, who had already had experience in work of a like nature. My colleagues entrusted me with the charge of the topographical work of the Commission, the result of which you now see displayed in the theatre of the Institution. A small portion of the line, near the mouth of the River Arta, was sketched by Turkish Officers, and throughout we had the assistance of Captain Lykoudis, one of the Greek Commissioners. The map, however, was almost entirely the work of the English. Captain de Wolski had charge of the trigonometrical and astronomical observations, while Lieutenant Leverson and I did the rest of the work. For the reproduction of the map we are indebted to the Intelligence Department. The admirable manner in which it has been executed there by Mr. Hawkins, in the section under the charge of Major Fox, R.A., has elicited well-deserved compliments from my colleagues. A period of seventy-five days, including all losses of time from rain, fog, obstruction, marches, and other causes, was employed upon the survey, which covers 232 miles in length, and about 1,000 miles in area. The rate was consequently about 3 lineal miles or 13 square miles per diem; and the work in the field was completed on the 15th

October, 1881, four months after the ratification of the Convention upon the subject.

The evacuation of the ceded territory by the Ottoman troops, and its occupation by the Greek forces, was carried out under the supervision of another Commission, upon which this country was represented by General Sir Edward Hamley, K.C.M.G., C.B., aided by Colonel Clery, Major Swaine, and Lieutenant Edgar Vincent.

The territory to be ceded was divided (according to the terms of the Convention) into six sections, of which the first was to be ceded within three weeks of the ratification of the Convention, four others within three months, and the last within five months.

The first section, comprising the tract between the Arta and the Aspropotamos, was duly evacuated on the 7th July, a considerable Greek force, under General Soutzo, marching into Arta upon that day, amid general demonstrations of joy on the part of the inhabitants, and the most perfect freedom from disorder.

A pause then ensued, in order to enable the Ottoman authorities to remove the large mass of war material and stores accumulated in Thessaly. On the 20th of August the Greek troops crossed the pass of Furka over the chain of Mount Othrys, and marched into Domoko, from which the Turks retired on the same day. Pharsala, Karditza, and Fanari, towns lying in proximity to the old frontier, were occupied on the 30th August, thus completing the evacuation of the second section, which, in general terms, covers the southern portion of Thessaly and the mountainous district of Agrapha.

Punta, which had been evacuated and occupied by a misunderstanding on the 6th July, was definitely transferred on the 10th September.

The third section, comprising the upper basin of the Salamvrias, with the towns of Trikala and Kalabaka, was handed over on the 5th. The fourth and fifth sections, comprising Larissa and Armyro, were transferred by the 13th September, with the exception of certain points on the frontier, which the Ottoman troops continued to occupy in spite of the adverse decisions of the Commissioners of the mediatory Powers. The Chief Commissioners for the evacuation thereupon left Thessaly, as there was nothing more to be done until the moment arrived for the transfer of the last section, that of Volo, which was effected on the 14th November.

With the exception of three localities on the line of the new frontier, known as Gounitza, Kritzovali, and Kara-Ali Derbend, to which the Porte still lays claim, the whole of the ceded territory was by that date entirely evacuated by Turkish troops, and occupied by the Greek forces.

Upon the points in dispute, all the Delimitation Commissioners of the mediating Powers held opinions adverse to the Turkish claims; and the Representatives of those Powers at Constantinople likewise rejected the appeal made to them on this subject.

In all other respects the transaction has terminated, and in a remarkably satisfactory way.

Sir Edward Hamley bears testimony to the admirable manner in

which Marshal Hidayet, the chief Turkish Commissioner, arranged the detail of the evacuation, and to his courteous desire to comply with such modifications as were proposed by the Commissioners of the Powers for general convenience, and he brings to notice that on the part of the Turkish Officers and men there was never the slightest display of ill-feeling. I must add my humble testimony in the same sense. I have often been associated with Turkish troops, and have a great admiration for their military virtues.

All the Greek authorities, military and civil, did also everything in their power to facilitate the labours of both Commissions.

It is most gratifying to record this exemplary conduct on both sides, and I am sure that you will share my hopes that the spirit of conciliation and amity which characterized the proceedings in this very delicate matter may pervade all their future dealings with one another. It is also most satisfactory to learn that the reception of the King of Greece by the inhabitants of Larissa, two-thirds of whom are Mahometans, was most enthusiastic. Difference of creed is no doubt a powerful barrier; but His Majesty's words must have reassured his new subjects. "I bring you," he said, "freedom and complete equality before the law. The Hellenic flag will be the symbol of order, safety, and independence."

Such may it be, and prosperity and contentment will be the lot of those who dwell within the New Greek Frontier after a separation, I might almost say an obliteration, of two thousand years.

The CHAIRMAN: Gentlemen, you have heard Major Ardagh's very interesting lecture, in which he has traced the history of the Greeks as a nation, and of the territory occupied by them from the earliest days to the last phase, when a new frontier was established, which now constitutes the boundary between Greece and Turkey. We shall be happy to hear the observations which any one may wish to make upon this interesting subject.

Sir WILLIAM CODRINGTON: I will not enter into the question of the new boundary (of which I know nothing); but Major Ardagh probably has not been as conversant as I was with the Treaty of 1827, as I was present in the Mediterranean shortly after the battle of Navarino. It is an error to suppose that the allied fleets "attacked" (which is the expression used) the Turkish and Egyptian fleets in Navarino. The orders to the Admirals were to protect Greece from attack. An armistice was agreed upon, but that armistice was broken by Ibraham Pasha, who with his fleet attempted an attack on Patras, but was turned back by Sir Edward Codrington with one ship of the line. Sir Edward Codrington thinking that that showed a yielding to the power of a small force, entered the Bay of Navarino, to secure the control of that fleet, which it was his order to prevent doing harm to Greece. When the fleet went in and had partly anchored, the first shots were fired by the Ottoman fleet; the "attack" therefore did not begin with the allies.

His Excellency the GREEK MINISTER: I wish to address a few complimentary remarks to Major Ardagh on his paper, to which I have listened with the greatest interest. By his intelligent and conscientious labours with regard to the new Greek frontier Major Ardagh is entitled to our esteem and thanks, and I am very happy to be the medium of conveying the expression of these sentiments.

The CHAIRMAN: As there seems to be no intention on the part of any present to occupy your time with a discussion on this paper, I will not venture to make any remarks upon it, except to say that the work conducted by Major Ardagh and his colleagues in the delimitation of the frontier displays great energy. It has been done in a remarkably short time and with very great success, and has produced the very beautiful outline map which you see before you. The Officers

had very considerable difficulties in the performance of their duties; difficulties of communication in a country where there are few roads, in fact, I may almost say no roads; where the population is very wild, and where strangers are subject to considerable risks in consequence of the ill-feeling existing between inhabitants of different religions and of different sides of the frontier. Although we read in the newspapers at that time that Major Ardagh had fallen a victim to some disturbance, happily neither he nor any of the European Officers were injured; although, I believe, some of the Turkish Officers did suffer. I may venture to say that we all hope that the aspiration which he has expressed at the end of his lecture will be realized, and that the issue of all the turmoil that has been going on for so many years on the subject of this frontier, may be peace and prosperity to the Greeks and Turks each within their own territory; and that those border difficulties will cease which have been the cause of so much trouble of late years, and that the settlement that has been arrived at will be of a permanent and satisfactory character. It only remains for me to ask you to give a vote of thanks to Major Ardagh for his interesting and admirable lecture.

Friday, July 7, 1882.

COLONEL LORD ELCHO, A.D.C., M.P., in the Chair.

"ON CERTAIN CONDITIONS OF SIGHT WHICH AFFECT ACCURATE SHOOTING."

By LITTON FORBES, M.D., F.R.G.S.

The CHAIRMAN: Gentlemen, the lecture about to be given by Dr. Litton Forbes appears to me to be on a subject that has never been treated before, as far as I know, in any lecture, or writing. Dr. Forbes was Surgeon-Major, and served in Turkey in the Servian War, where he had many opportunities of seeing shooting in war. Being a scientific gentleman, he has turned his mind to the effect, as regards shooting, of the construction of the eye in different men, varying as it does in every man more or less. It is especially interesting, because those who are volunteers and all who have been interested in shooting know that a question has been raised that has caused a great deal of feeling one way or another as to whether the orthoptic should be allowed at Wimbledon or not. I was always in favour of its being allowed, and happily this year the restriction upon it has been taken away, and it is to be allowed.

DR. FORBES:—My Lord and Gentlemen,

In considering some conditions of sight which interfere with accurate shooting, I propose to confine myself almost exclusively to certain of those less obvious defects of vision which there is reason to believe are in many cases unknown, and even unsuspected by those who suffer from them. As regards more marked and evident departures from the standard of healthy vision, such as high degrees of short sight, long sight, or pronounced astigmatism, I shall not trouble you with any remarks of my own. This for two reasons. First of all, because those whose eyes are thus affected are themselves well aware of the fact, and are as a rule able to discover an appropriate remedy. Secondly, because the subject of defective vision in its more marked forms, as bearing upon the conditions of military life, has been handled in so masterly and exhaustive a manner by Surgeon-General Longmore, in his well-known "Manual of Instructions," that I feel unable to add anything new to what he has already so clearly and ably stated. I shall not therefore say much touching those obvious defects of vision which in civil life as a rule compel a man to wear glasses more or less constantly. I shall confine myself mainly to those, as I believe, not uncommon conditions of sight, in which the eye as an optical instrument is imperfect, indeed, yet not so imperfect but that the routine-

work of daily life can be carried out without the adventitious aid of spectacles or other artificial appliances. But however fairly a man may succeed in performing an ordinary day's work without that high standard of vision which the majority of men in this country enjoy, he will, I believe, without it, never become a first-class shot. The conditions of vision required for long-range shooting are at the present time very severe. The use of weapons of precision, such as the Martini-Henry and other rifles, make demands on the faculty of sight which the older and less accurate weapons never did. Apart from the fact of the great distances at which good shooting is now made, the mere mechanical conditions required in sighting are themselves an optometric test of the most searching character. It is only necessary to consider the relative positions of the sights on a rifle, in conjunction with the distance of the target, to become aware of this fact. From an optical point of view a target at 600 yards may be said to be at an infinite distance. In other words, rays of light proceeding from it would enter the eye parallel, and would therefore, in a well-formed eye, throw a clearly defined picture of the object on to the retina or sensitive screen, at the back of the eye, without any effort on the part of that organ itself. The front sight in an Enfield rifle is about 34 inches distant from the back sight, and this latter again is, in the case of an average man, from 20 inches to 10 inches distant from the eye, according to the position adopted in firing. The prone position, which for many reasons appears to be the best for long-range shooting, places the back sight about 10 inches from the eye. The rays of light enter the eye from these three objects, that is from the back sight, the front sight, and the target, at different angles of inclination. The task which the eye therefore has to perform as an optical instrument is to focus these rays of light on the retina, and thereby form three pictures, sharp in outline and distinct in detail. A well-formed eye is perfectly capable of performing this task, as the scoring at the great matches year after year abundantly demonstrates. But an eye in the slightest degree defective will certainly not be able to accomplish it. The test, from a purely optical point of view, is a searching one, such a one in fact as is demanded of the very best photographic lenses. It is well known how a slight imperfection in a lens will mar the resulting picture. It is also known that a comparatively poor lens may be used for certain kinds of photographic work with fair success. It is exactly the same with the eye. An eye possessed of vision quite sufficient for ordinary purposes, and even good enough to satisfy the severest tests of military service in England or any foreign country, may, and, I can say from a large practical experience, often does reveal hitherto unsuspected imperfections when tested by the unusual and severe requirements of long-range shooting. These imperfections are of two kinds, viz., either acquired or congenital. In the former case, that is when acquired, they are often progressive. They become worse year after year, until many a man, who has made excellent scoring in the past, is driven practically to abandon match shooting from failing sight, and this at a period when his other powers of body are unimpaired. In the latter case, that is when congenital, the

existence of such imperfections are very commonly unknown even to their possessors, who fancy that their eyes are as other men's. As a matter of fact, however, such is very far from being the case. Their eyes do differ optically, and it is these often slight departures from the standard of absolute perfection of vision which prevents so many men from ever becoming good or even fair shots. The symptoms of imperfect vision in slight degrees, when using the rifle, are somewhat as follows: The back sights in aiming appear blurred and hazy, the edges are lacking in sharpness of outline, or perhaps show colours of the rainbow. Or if the back sights are clear the fore sight is not so. When looked at in conjunction with the back sight bar it seems hazy and indistinct. The target may also present either an indistinct or possibly even a distorted outline. At no given instant are the target and fore and back sights sharply and clearly defined when looked at simultaneously, as in taking aim.

The causes of these phenomena are not far to seek. They depend on certain imperfections of the organ of vision, which until very lately were not understood even by specialists, and which, notwithstanding all that has been done of recent years, I venture to think, have not yet received the full attention they merit. Before examining further into these causes, it may conduce to clearness once more to state the terms of the problem which the eye is called on to solve when sighting a distant target. It is this, viz., "To bring to a focus rays of light proceeding simultaneously from three objects at varying distances, one of which is at an infinite distance, and one of the others at a distance of from 10 to 20 inches." Now this is a problem the conditions of which no artificially constructed lens could be made to fulfil. A lens could indeed readily be made to depict on a screen placed behind it, with perfect clearness, the outlines of an object 10 inches off, or at a distance practically infinite. But to do this the screen would either have to be moved backwards or forwards, or the lens itself changed for a stronger or a weaker one, according as it was desired to depict either the nearer or more distant object. Were this not done, either one of the two objects when thrown on the screen would be out of focus, that is, would have a blurred outline and hazy appearance. This is exactly what happens in the eye when from any cause the delicate mechanism of sight has become impaired. Either the image of the near object, that is the back sight of the rifle, or the far object, that is the target, is blurred and indistinct. They are not simultaneously clearly defined and sharply outlined.

The power by which the human eye is able to see with equal distinctness an object at an infinite distance and an object close at hand, is known as the power of "accommodation." This power resides in the lens of the eye. It may briefly and with sufficient accuracy be said to consist in a change of shape of the lens itself. In early life this inherent power exists to a much greater degree than at or after middle age. Indeed, according to the researches of Professor Donders, of Utrecht, it is continually failing from infancy to old age. Its failure is, however, perfectly regular and constant, and is in no sense a disease. It is a physiological change in the eye itself, analogous to

the advent of grey hair or wrinkles, as age approaches, in the body generally. The ratio of this failure is well known. An object which at four years of age can be clearly seen at say 3 inches, at the age of forty-five cannot be seen much closer than at about 8 inches. The near point of distinct vision has in fact receded just so much. The least distance at which an object can be clearly seen continues to diminish up to the most advanced age, until finally it may be said to have completely ceased to exist. At the age of seventy-five the nearest point of distinct vision is about 2 feet in front of the eye; in other words, under no circumstances, nor with any effort of its own, can the eye see a small object distinctly within this distance. The practical bearing of these facts on rifle shooting is abundantly evident. In a series of measurements which I have recently taken, I find that in men of average stature and length of arm, the back sight is, in the prone position, distant about 10 inches from the eye; in other positions about 20 inches. It is evident, therefore, that a man, say of the age of forty-five, with a constantly increasing far sight, would at 10 inches be unable to focus clearly the back sights. He could do so with more success at 20 inches. Even at this distance, however, he would not be perfectly at his ease, for as his near point recedes, so also does the effort necessary to bring it nearer to the eye become greater. The eye, therefore, if the act of aiming was at all prolonged, might fairly be expected to exhibit signs of fatigue. This, as a matter of observation, it often does, as shown by either a sense of uneasiness in the organ itself, or a sudden loss of distinctness in the objects looked at. Moreover, inasmuch as the harmony of the component parts of the eye are disturbed, more or less of what is known as chromatic aberration is developed, that is the edges of the back sight are not merely blurred, but also coloured, a condition extremely opposed to accurate aiming. In such a case the mere position in which the rifle was held might influence the score very considerably by rendering the conditions of aiming more or less difficult. This condition of impaired vision is known as presbyopia, or "old sight." In civil life it is easily and effectively corrected by the use of suitable convex glasses for reading or other near work. In rifle shooting, however, this is not possible, for the correcting glass, which would make the back sight clear, would at the same time render the front sight, and still more the target itself, blurred and indistinct. To correct this condition of vision we are therefore obliged to have recourse to another method, which I shall describe later on.

But although the existence of slight degrees of "old sight" is a serious hindrance to accurate shooting, it is, when it occurs singly, by no means absolutely incompatible with it. If uncomplicated by other imperfections, it is not only capable of alleviation, but also is never present at an age when a man's shooting powers are at their best. Unfortunately, however, it is very frequently associated with another condition of vision, known scientifically as hypermetropia, or "long sight." This condition is the exact antithesis of short sight, or myopia. Unlike old sight, or presbyopia, it depends not on any change gradually taking place within the eye, but on a faulty shape of the eye-ball itself. In a well formed eye,

rays of light coming from the horizon are brought to a focus on the sensitive screen or retina, without any effort on the part of the eye itself. But in the long-sighted, or hypermetropic eye, such is not the case. The focus for parallel rays falls beyond the limits of the eyeball, or, in other words, they are never brought to a focus at all, unless an effort is made by the eye itself. Now this effort can only be made at the expense of the accommodation, and, consequently, a certain portion of the available power of accommodation is, so to say, wasted in the endeavour to gain a distinct view of distant objects. But, as already stated, the advent of "old sight" depends on the failure of accommodation. If, therefore, a certain proportion of all the available accommodation be required in order to neutralize a certain defect in the form of the eyeball itself, it is evident that a less amount will remain to correct or compensate for those changes which age, in the natural course of things, produces in the structure within the eye itself. In this way can be explained the apparent advent of "old sight" in young men. It is only within very recent times that this condition has been understood, and its great practical importance recognized. A glance at the diagram on the wall will show that the hypermetropic eye is essentially a short eye from before backwards. It is, as it were, an undeveloped eye, in contradistinction to the short-sighted eye, which might be called over-developed. I have met with this condition of sight most frequently among recruits from rural districts, though it is also common enough among dwellers in cities. This defective form of eyeball is born with a man, and therefore cannot be directly remedied. When it exists in high degrees it frequently causes squint, or shows itself in other obvious ways. It is a common cause of so-called "weak sight" in early life, of headaches, of a sense of weight in the eyeball and eyelids, and of other unpleasant symptoms. We are now, however, chiefly concerned with it when it exists in slight degrees. It is then often masked by the excessive power of accommodation which the eye possesses in early life. It does not, perhaps, show itself until either the work of education, with its consequent strain on the eyes, has commenced, or until some crucial test, such as that afforded by sighting a target at long ranges, is applied. When a hypermetropic eye is called on to satisfy such a test if the amount of hypermetropia present be not large, and especially if the power of accommodation be still strong, it may not immediately fail. The optical conditions required for aiming with one eye are not quite so difficult to satisfy as is the condition of reading at short distances with both. But long before the accommodation would fail in the ordinary eye, it will have failed in the hypermetropic. Owing to there being less available accommodation, old sight, with all its attendant disadvantages, will have set in. Moreover there can be little doubt that the mere act of accommodation, when required for viewing distant objects, impairs that perfect harmony between the various factors of the dioptic system necessary to perfect vision. This impairment may be expected to show itself in a want of distinctness in the front and back sights. The target will probably, in a young hypermetrope with good accommodation, appear distinct enough, but the edges of the

back sight and bar will be blurred and fringed with colours. As hypermetropia depends essentially on the fact that the eyeball itself is too short for the dioptic system which it contains, it is evident that in proportion to the amount of shortening present, so will be the amount of hypermetropia. High degrees are easily detected by any one familiar with such cases. It is not so, however, with low degrees, which I have every reason to believe exist much more frequently than is generally supposed. These require peculiar methods of examination for their detection, combined with a certain amount of time and trouble. I am persuaded, however, that it is well worth while for any man who aspires at being a good shot, and who feels that his sight is not quite what it should be, to undergo an examination for latent hypermetropia as a necessary preliminary. Such an examination may save an immense amount of useless practice, of loss of time, and of consequent disappointment. This examination is all the more advisable because the condition known as hypermetropia is easily corrected by suitable glasses. The imperfection of vision is here not due to the same causes as in "old sight." There the employment of a lens to improve vision was impossible, because the lens would necessarily render distant vision indistinct. In hypermetropia a suitable lens increases the refractive power of the eye, and makes sight as acute as it would have been had the eyeball been of the normal length. By the use of glasses distant objects can be clearly depicted upon the retina without any undue effort on the part of the eye itself, while the power of the accommodation is preserved intact for the purpose it was primarily intended to serve. The important fact about hypermetropia, so far as accurate shooting is concerned, is that it may be present in very slight degrees, so slight indeed as to be wholly overlooked, and yet that it may be sufficient to interfere very disastrously with accurate aiming and large scoring.

I now pass on to consider the opposite condition of hypermetropia, that is myopia, or as it is popularly termed "short sight." In this case the eyeball instead of being too short is too long. In other words, its axial length is less than its focal length. Parallel rays of light are, therefore, not brought to a focus actually on the retina, but at a greater or less distance in front of it. The resulting image is consequently blurred and indistinct. This is the case especially with distant objects. By no unaided effort of the short-sighted eye can objects be seen distinctly. Near objects on the other hand can be seen much closer than in the case of the normally constituted eye. In the hypermetropic eye the amount of hypermetropia is measured by the amount of accommodation required to see clearly the distant horizon. In the short-sighted eye we are concerned chiefly with the fact that the accommodation is often practically in abeyance, and that while within certain limits near objects will always be visible, distant objects will always be hopelessly blurred and indistinct. Short sight has nothing to do with the position of the near point. Its degree is determined solely by the farthest boundary of vision. The short-sighted eye cannot see the horizon or a distant target clearly, but within certain limits, within these distances, it can see objects quite

distinctly. Of all imperfections of sight existing among large bodies of men short-sightedness is the most frequently met with. This is particularly the case among recruits from urban districts, for causes to be mentioned later on. In the class of conscripts in France for the year 1878,[1] Dr. Nicati states that out of 3,357 total rejections for bad sight from one cause or another, myopia accounted for 511. In 1879 it accounted for 378 out of a total of 3,468. To understand the full significance of these figures, we must bear in mind that according to the statements of French authors themselves the standard of vision in the French army is exceptionally low. Thus, while Germany requires from her recruits for general service an amount of vision not less than half the normal amount, and while England requires somewhat less than Germany, France is satisfied with a quarter. Now these high degrees of myopia are comparatively rare. The lower degrees are far more frequent relatively. For one man who possesses, say, one-tenth of myopia, there will be at least half a dozen who will possess amounts less than this, say from one-twelfth to one-sixtieth, seventieth, eightieth, or even still less degrees. In civil life, under many circumstances, a low degree of short-sightedness is not a very great disadvantage. If a man can see clearly objects within, say, six feet, he would, by many, be considered scarcely short-sighted at all. He would simply have a more or less hazy horizon, a condition readily enough corrected by an eyeglass. These low degrees of short sight are, I have reason to believe, much more common than is generally supposed. Theoretically we might expect to meet them frequently, because short sight depends on a slight elongation of the eyeball itself. Now, in the conditions and surroundings of civilized life, there are many circumstances which predispose to this lengthening. A very slight amount of disproportion between the focal length and the axial length of the eye will produce a considerable deterioration of vision. Thus, a lengthening of only one-eightieth of an inch will cause, according to a calculation I have made, about one-fortieth of short-sightedness.

Now it is exactly with these very low degrees of short-sightedness that we are most concerned. The conditions of rifle-shooting are in many respects different from those of other arms, just as the constitution of a volunteer battalion differs in many respects from that of a line battalion. While no country would exclude a recruit because he possessed a fortieth of myopia, we shall see that this amount if uncorrected would almost incapacitate for long range shooting. By this expression I do not mean altogether shooting at a target a long distance off. I mean rather that faculty of quick and accurate sight, which enables a man to judge distance correctly and to fire quickly, which enables him to take in a glance the salient features of distant objects, and the characters of a country or landscape, and which, moreover, enables him with the quickness of thought to distinguish the arms and estimate the force of any hostile body he may chance to encounter within the extreme range of his rifle. Now it is interest-

[1] "Archives d'Ophthalmologie," Mars—Avril 1882.

ing and instructive to consider for a moment the actual effect on this sight for distance, of these low and almost unnoticed degrees of myopia. Dr. Girard Teulon, of Paris, from a series of experiments, concluded that a physiologically acute eye which was myopic only one thirty-sixth, lost thereby about half its faculty of vision. Professor Nöel, of Louvain, perhaps a more accurate authority in this matter, states that acuity of vision useful for distant objects varies between two-thirds and two-fifths for a myopia inferior to one forty-second; it is below one-fourth from one-thirtieth to one-twentieth, which are the limits accepted in recruits in this country, for a myopia of one-sixth to one-fifth, such as is allowed in the French and Italian armies, distant vision is only one-thirtieth of what it should be. But the English soldier is not allowed to wear glasses, and perhaps rightly so; still it is impossible to help inquiring what sort of shooting a man on active service would be likely to make with an arm of the Martini-Henry type, when possessed only of one-fourth of normal vision. "To such a man at the distance of fifty yards and upwards groups of five or six persons standing together before a dark background cannot be counted with accuracy. More distant objects such as the general features of a landscape are huddled together, and become little else than shadows with indeterminate outlines. The nature of particular objects of large size can only be made out when the accidental advantage of some sharp contrast is afforded, such as is presented by a ship floating on water, by a building or a tree having the sky as a background, or when a well-known object, such as a horse, is in movement on a road. Even this last object ceases to be distinguishable at a distance of seven or eight hundred yards, if it be passing by a dark background such as a belt of trees."[1] But there is still another disadvantage to which the short-sighted man is subject, which is that as the light fails his vision fails much more quickly than does that of an individual with normal sight. This depends on the fact that in proportion as the pupil dilates, so the circles of diffusion increase on the retina. Even very low degrees of myopia become, therefore, a great disadvantage in the use of the rifle towards evening, or in dull and cloudy weather.

The existence of low degrees of short sight does not, as is popularly supposed, preclude the presence of "old sight." In old sight the near point of distinct vision has receded beyond ten inches. If a man is therefore short-sighted only beyond, say, forty inches, it is clear that he may be presbyopic for near, and myopic for distant objects. This simultaneous existence of two distinct conditions of impaired vision is, I have found by experience, far from uncommon. It is a condition, however, very frequently overlooked, and is a source of great annoyance and perplexity to the person who is the victim of it. In such a case vision both for near and distant objects is blurred and indistinct. Moreover, the power of accommodation in a myopic eye is very often, through want of use, weaker than it should be. Consequently, in such persons presbyopia may come on earlier than in properly formed eyes.

[1] Longmore, "Manual of Instructions," p. 77.

A man of, say, fifty years of age, with one-fortieth of short sight, would not be able to see the target clearly nor the front sight, because they would be beyond the limit of distinct vision, which in his case is forty inches. But inasmuch as his near point of distinct sight has also receded beyond ten inches, he could not in the prone position of firing see the back-sight. Yet such a condition of sight might easily escape notice in civil life. Many persons indeed would be satisfied with the use of a weak convex glass, which would enable small print to be read at the distance of about a foot. In rifle practice, however, such a glass would be inadmissible, because, although it might render the back sight clear enough, it would hopelessly blur the front sight and target. The addition of a convex glass of one-fortieth would exactly double the myopia, changing it from one-fortieth to one-twentieth, or according to Professor Nöel's calculation, reducing the acuity of distant vision to one-fourth what it should be. A combination therefore of "old sight" with low degrees of short sight seems a most hopeless condition of vision so far as rifle shooting is concerned.

In cases where the power of accommodation is still good, that is, where "old sight" has not yet supervened, I cannot myself believe that the existence of low degrees of myopia should necessarily be fatal to good shooting. Of course the existence of any myopia will blur more or less the horizon and all distant objects, and possibly even the front sights. The back sight also will not be quite clear because, although theoretically, it does not lie beyond the range of distinct vision, yet practically, owing to the optical conditions of the eye, its image will be thrown on the retina in an ill-defined and imperfect manner. The edges will be blurred, and more or less iridescent, and correctness of aim will thereby be very much interfered with. In these cases the proper correcting glasses should be worn constantly, not only while firing, but at distance-judging drill, and generally whenever a man has a rifle in his hand. Short sight is not a disease. It is simply an optical condition of the eye, which in low degrees is completely under control. When present in a limited degree it may be completely corrected by glasses, and sight be rendered for all practical purposes perfect. I must protest, however, in these cases against the occasional and fitful use of glasses, and certainly against eye-glasses in general. A man with a slight degree of myopia, who wishes to be a good shot, must have suitable spectacles which will accurately correct, and no more, his short sight. These he must wear constantly, in order to get accustomed to the appearances of objects at varying distances. An occasional use of glasses is, I believe, worse than not using them at all. Let the marksman, therefore, either learn to shoot with or without them, if indeed this latter alternative be possible. To wear them occasionally at the firing point, or in matches only, may possibly help the score. Such a course will, however, most certainly prevent a man from acquiring that perfect mastery of his weapon, which it should be the object of everyone to attain to who takes a rifle in hand.

There is also another point of view from which this subject of short-

sightedness assumes great interest and importance. I have already referred to the fact that by many oculists the hypermetropic eye is considered an undeveloped form of eye. Conversely the short-sighted eye may be considered an over-developed eye. Certain it is that much of the ordinary work of civilized life tends directly to the production of this over-development, or, in other words, of short sight. This fact has been brought out very clearly by the researches and observations of Dr. Cohn in Breslau, Drs. Agnew and Loring in New York, and Dr. Erismann in Russia. Dr. Cohn, with Teutonic patience, examined the eyes of 10,060 children, among whom he found that 1,004 were short-sighted. But what was more important, he found also that the short-sightedness increased steadily both in the relative number of cases, and in degree as he ascended from the elementary to the higher classes. Dr. Loring, of New York, carried out a similar series of observations on the students of one of the largest universities in the United States, during the graduation period of four years. He found that, in a given number of individuals, each successive year of study added to the number of short-sighted persons, or increased the degree of the defect where it already existed. Now, the whole tendency of modern life is in the direction of those employments which are calculated either to produce myopia, to to aggravate it if already existing. Education is now carried on at high pressure, without much regard either to the eyes or the bodily health of the disciples. Children begin to study earlier and continue at their books to a much later age than they did a generation ago. There is an increasing dislike to occupations requiring manual labour, and a corresponding desire for those entailing head work only. Nor is this condition of things likely to be materially altered in the course of succeeding generations. On the contrary, as the struggle for existence becomes intensified, and as the process of centralization which is so marked a characteristic of this age becomes more developed, so may we expect to find that the number of those employed as clerks and penmen, or at sedentary occupations generally, will increase relatively faster than the population itself. Reason and analogy both go to show that one direct result of all this will be a very considerable increase of short sightedness among those classes which in England at least have heretofore enjoyed a comparative immunity from it. As a rule volunteer corps are chiefly recruited from these very classes, and therefore the existence of any great increase of short-sightedness among them is a matter for serious consideration. Much can be done in the way of prevention, and much also in the way of cure. But I am of opinion that the first symptoms of the advent of short sight should be carefully looked for in young recruits, and when detected should be at once treated by suitable glasses. These should be worn as a matter of course on all occasions when the rifle is handled, and more especially at distance-judging drill and target practice. The education the eye will thus receive will be invaluable for practical purposes, and in this way, and in this way only, can a short-sighted man ever be made into a good or useful marksman.

I now pass on to the consideration of another condition of vision

which interferes very considerably with accurate shooting. I refer to what is known as astigmatism. This condition may be described as one in which the curvature of the front of the eye is different in the horizontal direction from what it is in the vertical. Probably this is the case in most eyes, and it is only when the difference of curvature is more or less considerable that the resulting astigmatism becomes a source of annoyance. Such a difference of curvature may cause an eye to be at one and the same moment far-sighted and short-sighted, according as vertical or horizontal lines are looked at. Or, again, the same eye may be wholly short-sighted or wholly far-sighted; but these conditions may exist in different degrees, according to the position of the objects looked at. Thus, it would be quite possible with such a condition of vision for certain portions of distant objects to appear perfectly distinct, while certain other portions, placed, say, at right angles to these, would be hopelessly blurred and ill-defined. Such a condition of sight, therefore, not only renders both near and far objects indistinct, but also to a very appreciable extent distorts their outlines. An astigmatic person can, in fact, see well neither at a distance nor near, nor is this condition sensibly improved by spherical glasses, such as are ordinarily used for spectacles. The detection and estimation of astigmatism is often a proceeding of some delicacy and difficulty. It requires special appliances, and in certain forms, indeed, that is in the so-called irregular astigmatism, does not admit of accurate correction. Astigmatism may be united with both far sight and short sight, and, indeed, seldom occurs in practice without one or other of these complications. To detect and correct it satisfactorily it is often necessary to paralyse for a short time this activity of the accommodation by means of atropine. In this way the exact amount of astigmatism can be found, and as it neither increases nor diminishes with age, it can be corrected once for all, either by the proper cylindrical glass, or by the union of a cylindrical and spherical lens.

The influence of even low degrees of astigmatism upon the sight is very marked, and is exerted in various ways. Its first and most obvious effect is to produce differences in the apparent distinctness of equal lines, drawn in different directions. In this way astigmatism produces indistinctness of some of the linear boundaries of figures, leaving others clearly defined. The indistinctness of many boundary lines produces a corresponding diminution in the acuity of vision, while the necessity of constantly altering the adjustment of the eye, while looking at different parts of the same object, produces great fatigue of the accommodation. Hence, astigmatic persons complain not merely of defective sight, but also of weariness and aching of the eyes. These symptoms are sometimes kept in abeyance so long as the accommodation is strong. But in proportion as this latter fails with advancing years, so does the astigmatism tend to increase, and every year to become more irksome.

As regards the effect of this condition of vision on accurate shooting I need not say much. To the astigmatic man, as to the myopic, all the sights of a rifle will be blurred, while neither sights nor target

will appear in their actual and proper shape. Indeed the relative distortion which objects undergo is the distinguishing characteristic of this condition of impaired vision. Its effects are most felt in judging distance, and in shooting at long ranges. As already remarked, it admits of correction by suitable glasses. These glasses, as I have already ventured to say in respect to myopia, should always be worn whenever the rifle is taken in hand. If only worn at matches they may indeed on occasions help the score, but they will not really confer any power of superior shooting under conditions which would assuredly arise in active service. An eye thoroughly trained to judge distances, and to study the features of a landscape through glasses, will be nearly, if not quite, as quick and accurate as one which is fortunately independent of such adventitious aid. The important point is that the training should be continuous, unintermittent, and thorough. In other words, a person whose vision requires glasses to raise it to the normal standard should never attempt to shoot without such glasses, for by so doing he will not only fail to shoot well, but will moreover deprive himself of a great portion of those benefits which glasses would undoubtedly confer upon him.

I have now considered the four chief conditions of vision which, whether occurring in low or in high degrees, may be said to interfere seriously with accurate shooting There are, of course, other possible conditions of impaired vision, such as commencing cataract, asthenopia, deep-seated changes in the eye itself, or a want of harmony between the optical conditions of the two eyes, which would also very materially affect the use of the rifle. These, however, may fairly be omitted, either because they tend to cure themselves, or else because they admit of no cure whatever, and, therefore, render rifle shooting simply impossible. The conditions which I have considered in detail in this paper admit, on the contrary, of almost complete correction. If detected early, if not too high in degree, and if properly treated, they are not, I believe, incompatible with a very high degree of excellence, not only in target or match shooting, but also in those other more varied and more difficult services which a body of trained riflemen might be called on to perform in actual warfare.

In considering how best to deal with the conditions of impaired sight which I have enumerated, it may be well to say a few words as to what has been already done in the same direction. The blurring of the back sights has long been a matter of complaint with good shots who are perhaps no longer young, and who find, as might be expected, that with failing sight their power of making large scores is also failing. The cure of this condition is, within certain limits, not difficult. The blur may be removed by the simple device of looking through a pinhole aperture. Or, were this not permitted, it might also probably be removed for a time by the instillation of a few drops of some agent which would contract the pupil to the size of a pinhole, and would thereby, on well-known optical principles, render the retinal images much more distinct and perfect. Such an agent is perfectly well known to oculists, and it would certainly, I think, be worth a trial by any person whose only object was to make a large

score on a given occasion. The stenopæic or pinhole-opening, which is really an artificial pupil smaller than the natural one, will also improve myopic, hypermetropic, or astigmatic vision for the time being. It does so in these various conditions by acting in different ways, which I need not now dwell on. There is, however, to my mind two fatal objections to the use of these perforated discs. The first is that they simply palliate or alleviate the impairment of vision without attempting to remove its cause or causes. The second is that it entirely destroys the field of vision, and limits sight to the single object which for the moment happens to be directly before the eye. It renders impossible, therefore, any accurate perception of surrounding objects, or any nice comparison between the several parts of objects which, as every one knows, is essential to the formation of a correct estimate of distance. No one, so far as I am aware, has proposed that any company should learn their drill armed with this appliance. Even although it should for the moment improve vision, it would do so at the sacrifice of what I take to be more valuable than even acute central vision, viz., uninterrupted vision over a large extent of country.

In considering how this difficulty might be met, and how the acuity of vision might be improved, while at the same time the range of vision in all directions was not lessened, I have kept two objects in view. One is to correct, that is remove the actual optical condition which is the cause of the impairment of vision. The other is to find an appliance such as may be worn at all times and under all circumstances, from the very day on which the recruit commences to learn his drill. The first of these indications is fulfilled by the use of glasses which will exactly correct the faulty condition of the eye itself. The sight should first of all be carefully tested, and the nature and degree of the impairment of vision be accurately measured. This will in many cases be sufficient, and if the glasses thus found be constantly worn, nothing more will be needed. The principle of the pinhole aperture is, however, an excellent one, and should, if possible, be preserved. In order to do this, without at the same time unduly limiting the field of vision, I replace the metal disc by a disc of coloured glass, perforated with a stenopæic aperture. This aperture admits white light, whilst the remainder of the glass allows only coloured rays to pass through. The resulting contrast, by a well-known optical law, serves the purpose of an opaque disc, without, like it, completely abolishing all but central perception. Having thus corrected the error of refraction, to which the impairment of vision is essentially due, by a suitable glass, and having also, by means of the contrast between the white and coloured rays, secured the main advantages without the drawbacks of the stenopæic disc, it remains only to unite, if possible, in one appliance this double gain. This might be effected in very low degrees of short or long sight by having a coloured glass ground to the proper focal length, and then perforated with a small conical aperture. But a practical difficulty exists in the way of doing this, owing to the fact that coloured glass, when ground into the form of a lens, becomes lighter in tint the thinner the glass is.

This difficulty has been met by using a coloured glass of uniform thickness, to the back of which the correcting glass, which must be either a plano-concave or convex lens, is fastened. In this way it is believed the double advantages of glasses and of the stenopæic aperture can be obtained simultaneously with a minimum of disadvantage. The instrument corrects at once any anomaly of refraction present, and, at the same time, while rendering central vision more acute, does not curtail the field. In simple cases of presbyopia the mere aperture, without any correcting lens behind it, will probably be sufficient. In certain forms of astigmatism a cylindrical lens placed in front of the coloured disc might occasionally be necessary; but the addition of this need offer no practical difficulty. Some little practice with this instrument will be necessary before its advantages become fully apparent. The instrument, which perhaps I may be permitted to call "the stenopæic sight adjuster," may be worn either suspended before one eye from the back of the cap, or in a spectacle frame. The latter method is preferable, because the small aperture can thereby be kept more steadily in front of the pupil, and also because the optical centre of the correcting lens, united with the coloured disc, will thus be kept directly in the line of sight. To fulfil this indication more fully, the spectacle frame should curl backwards round the ears, by which means a firmer hold and greater steadiness can be obtained. As regards the other eye even though not employed for aiming, it should nevertheless be provided with a proper correcting glass, that is if it suffers from any optical imperfection which impairs its acuity of vision for distant objects. In the case of simple uncomplicated presbyopia this will not be the case, and therefore a disc, such as I recommend, used before the right eye, would probably be sufficient. In most cases, however, presbyopia is complicated with low or varying degrees of hypermetropia, myopia, or astigmatism, as already explained. Such a condition requires not merely a stenopæic opening, but also a correcting lens behind it, in order to restore the imperfectly formed eye to the same optical condition as a normal eye.

It will be observed that before this instrument can be used the "refraction" or optical condition of the eye must be tested, and the correcting lens made accordingly. Once the proper glass, which corrects the optical error, has thus been found, I hold that that glass should constantly be worn on all occasions when the rifle is in use, whether for purposes of firing or of mere drill. Spectacles, if worn only occasionally, are, so far as concerns the practical training of a marksman, rather a snare and a delusion than a help. If, however, they are worn constantly, the eye becomes accustomed to their use. It learns to note accurately and readily the delicate play of light and shade, and the changes produced in the forms of objects at varying distances. If, however, along with this, central acuity of vision can be increased, while its lateral range is not destroyed or even impaired, the gain would be still greater. Whether I have succeeded in accomplishing this object, the practical test of experience can alone show. Meanwhile the great importance of the subject of slight imperfections of vision in regard to the use of the rifle, in every branch of the service,

must be my excuse for having ventured to bring this paper before the Royal United Service Institution.

The CHAIRMAN: Now, gentlemen, if any person present who has turned his mind to this subject will offer any remarks, I have no doubt everybody will be glad to hear them; or if any gentleman wishes to ask any questions with reference to this very interesting paper, I have no doubt Dr. Forbes will be willing to give any explanation that may be required.

Mr. CURTIS: My object in addressing you, my lord, is simply to take a slight objection to one statement made by the learned doctor. He speaks of the orthoptic entirely destroying the field of vision. Now, if anybody looks through an orthoptic disc he will have at a distance of 600 yards a field of vision 200 yards wide. Here is one, if any gentleman likes to look through it; and standing at six feet from the wall, I will guarantee that he shall see two feet spaces at least. I cannot help thinking that it is that idea that made the Association object to it for fear it might endanger the lives of the markers.

Mr. GEORGE BAKER: I should like to ask the doctor if he has ever got a hole sufficiently clean to give a clear margin. That is always the difficult thing in trying to drill a hole or aperture in glass—to get it sufficiently clear, but it is essentially necessary that any aperture in a disc should be clean cut. We have tried a great number, and we have never succeeded at all effectually.

Mr. CURTIS: I tried your system some years ago. The disadvantage of it is it admits light to the aperture sideways. I have one here in my pocket with a round clean cut conical aperture that I made a long time ago, but could never use it for shooting purposes.

The CHAIRMAN: A glass with a hole in it?

Mr. CURTIS: Yes; you can compare it with Dr. Forbes'. It is simply a dark glass with an aperture in the centre. One eye of these spectacles is fitted with an "orthoptic," and the other with a "stenopæic" for comparison. The disadvantage of the latter is seen more out in the sunlight.

Captain BEDFORD PIM, R.N.: I should like to thank Dr. Forbes for his very able paper. I for one am very much obliged to him, because my son, who is in the "Devil's Own" Regiment of Volunteers—a most distinguished regiment—has been trying for a long time to become a good marksman. Now when I had the honour of being leading file in Company A in that regiment, I was a good marksman, and got a marksman's mark, but my son cannot manage it. I see the Doctor makes a suggestion that an examination should be made. I think that a very capital suggestion, and I shall take care at once that my son is examined by a well-known oculist, to see whether he had better persevere, or whether there is some optical delusion in his eye. His cousin, Sir Charles Locock, is the great marksman of the Devil's Own, and he has been encouraging my son to come down and practise, but he cannot manage to make much progress, though he perseveres day after day. I should have liked Dr. Forbes to have gone a little into the question of sight at sea—sight with regard to different colours at sea. We have the most extraordinary evidence in the Law Courts with regard to colours. This very day I have been in the Court, and a man swore positively that for 15 minutes in the case of the "Douro," when the ships were going at 10 knots an hour, he had seen the green light of the Spanish ship. Now it is quite impossible to see a green light under any circumstances of weather, no matter how good they may be, for more than 2½ miles, yet he swore positively that he had seen that green light, which must have been at the very least, supposing his time was correct (15 minutes), 5 miles off. I find Dr. Forbes has not alluded to that. He appears not to have alluded to colour at all, but the subject is of such great importance to the Army and Navy and Reserve Forces, and all armed forces, that I believe he will forgive me for just giving him a hint to turn his attention to that very important subject. It would be of great use to sailors, for the imperfect vision of the look-out man has caused many and many a collision, and the loss of hundreds if not thousands of lives at sea. I for one most cordially thank Dr. Forbes for his very able paper.

General BLUNDELL: I merely wish to ask whether fog does not prevent glasses assisting short sight.

Mr. RAGLAN THOMAS: As a member of the medical profession, and also a rifle shot, I have taken very great interest in the lecture, and beg to join in the expression of thanks to the lecturer. I trust he will excuse me for having been a few minutes late. Possibly one of the questions I am going to ask may have been answered in the first five minutes. I wish to ask whether he does not consider that the back-sight of the Snider rifle is too near the eye. Last year, until the abolition of the back position, I never found any difficulty at all in my vision; at all ranges I was able to do a steady score, but since the back position has been abolished, I have found great difficulty in shooting, especially with the Snider rifle. During the earlier part of the season I shot entirely with the Snider, because I had no Martini ammunition. I found that with the Snider rifle I could scarcely shoot at all, but with the Martini I certainly found it different. I find I can generally see fairly, almost as well as I could on the back, but that the power of vision fails slightly at the long ranges, especially at 600 yards; there arises a slight blur, and I think my vision must be slightly hypermetropic. I have also tried the orthoptic, and find that with the smallest and the second size hole—there are generally three holes drilled—there is a film in the centre of the aperture, but not so much so in the larger hole. I shall take an early opportunity of consulting one of my professional brethren, who has given great attention to the subject of eyes.

Dr. LITTON FORBES: As regards the orthoptic destroying the field of vision, of course that statement must be taken in conjunction with the context. I consider it limits and practically destroys the field of vision for purposes of drill, and would interfere in general warfare with details of great importance, such as judging distance, and so forth. The sole end and aim of the Volunteer organization of this country is not merely to shoot at targets, and I do not believe it would in practice be possible to drill or utilize in the field any company of men wearing orthoptics. Looking at the instrument from a purely optical point of view, when you place an orthoptic in front of the eye, you cause the rays of light to enter that eye more readily, in accordance with the mathematical laws which underlie physiological optics, and thereby you do away with the source of the inherent imperfection of the organ of vision, but you lessen at the same time the range of the ocular movements and the range of vision. Looking through a pin-hole, you can see an immense range of country on either side, but attempt to use the orthoptic in the various details of judging distance, of examining a landscape, &c., and you will at once, I think, find it impossible to do so successfully. As regards Mr. Baker's statement about the difficulty of drilling holes in glass without chipping, I must say I did find that a practical difficulty. In laying these models before the Royal United Service Institution, I do not wish to lay claim to any particular novelty or success. What I had hoped to elicit from the members who have had more practical experience than I, was as to whether anything could be done in the direction of keeping the advantages of a stenopæic hole, while at the same time, by utilizing the "law of contrast," of keeping also some of the advantages of the free movement of the eye, and with it the power of taking in rapidly large stretches of country: in other words, of judging distance. I think what I have said will answer another suggestion. I have made a good many experiments, but at present I am only working tentatively, and the reason I have brought this paper before the Society just now is the near approach of the Wimbledon meeting. If I had had plenty of time probably I should not have volunteered to place anything before you to-day, but I do hope that somebody following on the same lines will hit on a thoroughly practical instrument. However, I think I may claim some originality in wishing to put the correcting lens behind the coloured disc of glass. In that way the advantages to be derived from the use of coloured glass may be secured, advantages which would be lost if you attempted to grind a lens out of coloured glass only. The stenopæic hole gives some of the advantages of contrast, but there may be a practical difficulty as to the edges of that hole. However, I have been assured by a well-known optician in London that it is possible to drill a hole in glass without chipping the edges. Captain Bedford Pim was kind enough to make some remarks which I am sure were

very pleasing, but I fear too flattering to myself. I should like to say that I have seen a good deal of sea-service, and have devoted some attention to what he has alluded to. The subject of coloured lights is a very large and important one. I believe that a vast number of men who are put on watch at night are not in a condition, so far as their eyesight is concerned, to go on watch. I last year in London examined with others over 8,000 cases for colour blindness, and an average of from 3 to 4 per cent. of impaired colour vision was found, with from 1 to 2 per cent. of complete colour blindness. It is of course easy to calculate from the above data how many out of, say, 10,000 men taken at random will probably have more or less colour blindness. As to seeing the green light at sea at unusual distances, it strikes me that the fact Captain Bedford Pim refers to may be explained in this way. It is well known that many persons who are colour-blind can yet learn to distinguish the colour of a light simply because the amount of illuminating power given out by various coloured rays differs. Hence, although to two persons a green light may seem equally colourless, yet one may see it more clearly and therefore further than the other. In this way may be explained the fact that engine drivers with impaired colour vision are able to avoid accidents. They cannot see the colours, but they can distinguish the difference in the amount of light given forth by red or green respectively. If, therefore, the witness mentioned by Captain Bedford Pim swore that he saw a green light seven miles off (which of course seems impossible), it could only have been that he recognized the light by some rule of his own, by which he had hitherto been accustomed to do so, and it is conceivable to me that a green light to a colour-blind man would at seven miles give at any rate a certain amount of distinction from a light of any other colour. As regards General Blundell's question, the optical effect of fog is, if anything, to shut out a certain amount of light. It has no bearing on the question of refraction proper. In other words, myopic or hypermetropic persons in clear weather or in foggy would be influenced by the regular laws governing vision, but inasmuch as the near-sighted eye with failing light tends to form circles of diffusion on its retina, the fog would probably interfere more with short-sighted than with long or normal sighted persons, because their pupils would dilate, and the diffusion circles therefore would be greater. As regards Dr. Thomas's statements about the Snider rifle and the back position, and that he can shoot better with the Martini than the Snider, the first part of his question induces me to believe that there is present in his case hypermetropia, with more or less loss of accommodation, and no doubt as years go on matters with him will get worse; but the latter part of his statement, viz., that he saw what appeared like a film, is distinctly a characteristic of astigmatism. A very good example of astigmatism may be obtained by holding the finger and thumb close together and looking through the interval between them. Anyone who does so will see, appreciably, before the thumb touches the finger, the formation of a sort of drop. That can be got over by looking through a pin-hole opening, when the actual contact of finger and thumb will be seen perfectly clear. I should make a rough diagnosis of his, Dr. Thomas's case, and say that there was a certain amount of hypermetropia complicated with astigmatism present; and also I should venture to add that the nearer the back sight was held to the eye, the more indistinct it would become, and the more difficulty he would find in aligning the target. A case of that sort, I should say, would require a good deal of examination, and possibly there might also be a question of the amount of accommodation present, and whether it was in excess or deficiency.

Mr. BAKER: I should like to offer one more remark in favour of the orthoptic, which is that I think it is analogous to a telescope where you have a series of lenses. You may take your eye as the eye-lens of the telescope, the fore sight is the object-glass, and the back sight the erector. Now, if you have more than one lens, and have no stop, no matter how well the lens may be ground, you will always get a great deal of distortion; but place a stop in at the proper point and everything is clear and well defined. I think that the orthoptic just meets the case exactly, and so gives you that accommodation that the eye has not naturally, and enables you to define all clearly at one time.

Dr. FORBES: The stop which nature has provided is the iris; the coloured part of the eye acts as a stop. If we interfere with that and put another stop on the top

of it, we must more or less mar the function of vision. Besides, considered from a scientific point of view, the orthoptic is really another sight, because, although you look through the orthoptic at the back sight, you really do away with back sight altogether. You also reduce the eye from a living organ of vision to the position of a mere mathematical or geometrical *camera obscura*. You allow a pencil of light to enter instead of the full rays of the sun. Of course, if you only admit a pencil of light, you bring the mathematical conditions down to much greater accuracy, but in doing so you suffer a certain amount of loss to the visual functions, and the natural adaptability of the eye to shooting. I quite believe that target-shooting is improved thereby, but in this paper I wish to suggest, if possible, some way of making general shooting better, under the varied and trying conditions which would have to be encountered in actual service.

Mr. BAKER: I agree that it would be more desirable, but I am afraid we are a long way off it.

The CHAIRMAN: It is my pleasing duty now to ask you to accord to Dr. Forbes a vote of thanks for the lecture which he has given us to-day. The hearty and genuine applause which he received at the conclusion of his lecture must have shown him, I think, how thoroughly it was appreciated, and when Captain Pim expressed his thanks to Dr. Forbes for the very able, scientific, and useful lecture he has given, he simply expressed the opinion of everyone who had the pleasure of hearing it. I am very glad indeed that we postponed it, for there were only six present the other day, and I think that number is multiplied to-day at least four or five times. I only wish that this room had been as crowded to-day as I have seen it on other occasions, when, perhaps, matters not quite so interesting were discussed. The impression left on my mind is how very blind we all are without knowing it, and that many men go on practising shooting who might well give it up. That is the only cause for regret I have that this lecture should have been given immediately before Wimbledon. If a man should come up and want to make bulls'-eyes, and instead of paying 5*l.* for entry, should go to an oculist and pay one guinea, and find that it was no use his trying, for he would never make a good shot, I think it would be a bad thing for the National Rifle Association. We have heard an exact case in point. Captain Pim told us he was a first-class shot himself, but he has not transmitted that power to his son. But his son is anxious to rival his father, and has been expending a lot of money on shooting, and now he is going to take him to an oculist, and we shall have no more entries from young Pim at Wimbledon or elsewhere. But the remedy lies, it appears, in glasses, and it strikes me that the opticians will have a great deal to do if all these natural defects of vision can be in a great degree remedied. I was always myself in favour of allowing orthoptics. As regards the question of danger, of course, if I hold the glass at a distance from my eye, I should see very little besides the target, but if I put it near my eye, I see half a mile on each side of the target; therefore, so used, I do not believe there is any danger. No doubt, when shooting in the back position, the pin-holes being a comparatively long way off, there was some danger, but now that the back position is mostly done away with, I do not think orthoptics are dangerous. The position of the back-sight has been referred to. There is no doubt about it, that as a man gets older he wishes to have the back sight further removed. The Officer at the head of Enfield has invented a new rifle which has gone out for trial, but I am sure no man who ever shot with a rifle in his life would ever have placed the back sight where he has placed it. The back sight is put so far back, and is of such a form, that I am certain no practical man who understands shooting and sighting a rifle would ever turn out such a rifle as the one referred to. As regards army shooting, I think General Blundell must feel that it is very desirable to overhaul the eyes of the Army in that respect, and when men are taken out to the targets day after day, and do not improve, it should be seen whether it may not be due to their state of vision. I do not think we can expect a large vote every year for spectacles. I wish General Walker were here, because I should have asked him the secret of so many Germans wearing glasses—whether it is that they are short-sighted from over-study in schools or elsewhere, as we are told, or whether it is what I have heard amongst the Officers especially—that they put on plain glasses, which are really not short-sighted glasses, to give an idea that they are very studious and

working very hard with a view to promotion. I do not know with what truth that is said, but I do not expect myself that we shall ever see the British Army a spectacled army. With regard to judging distances my belief is that, beyond a certain distance, teaching men to judge distances is all rubbish; it is all chance, unless you have some sort of instrument, and it will come to that that we shall have some sort of instrument practically for judging distances. I do not believe it is practicable to get a whole regiment to shoot up to the full range, or anything like it, of the Martini, with accuracy. You will not find 600 men up to the same mark in a regiment, any more than in an orchestra all the players will be able to play as well as a certain number of crack violinists in it. We probably may not return to the flank companies of the olden days; but Captain Pim will bear me out, that in the Devil's Own, Colonel Brewster, the commander of that distinguished corps, and a distinguished rifleman himself, when his regiment was sent out, instead of sending this or that company out, his word of command was, "Marksmen to the front;" so that when the enemy was at a distance he sent out the marksmen, and when the fire got nearer the others took it up; and I believe that if you have picked marksmen in sections, working under trained section leaders, who are able to judge distances for them, you will get certain good results in that way, and make use of the good-sighted men, and when the work becomes rougher and nearer and such accuracy is not necessary, you can then use the mass of your troops. You will thus save ammunition and do more effective work than you do under the present system of attack. I do not know that I have anything else to say further than this, that as regards the question of lights at sea, I would remind Captain Pim, that either last year or the year before a Committee was appointed to inquire into this matter. As regards fishing vessels, I quite forget what the report was, but it all turned on what would be the best colour and arrangement for lights, and if Captain Pim will refer to the report of the Committee in question, he will find some information with respect to the distance at which different coloured lights can be seen. Mr. Birkbeck, who has taken such an active part in the Fishery Commission, was in the chair. I have no further remarks to make. I apologize for having ventured to make these, and I ask you to give the most cordial and hearty thanks to Dr. Forbes for his interesting lecture.

Friday, May 19, 1882.

ADMIRAL SIR FREDERICK W. E. NICOLSON, BART., C.B., Vice-President, in the Chair.

THE RELATIONS BETWEEN THE SIZE, SPEED, AND POWER OF MARINE ENGINES.

By RICHARD SENNETT, Chief Engineer Royal Navy, Memb. Inst. M.E., &c.

I NEED scarcely remind the members of this Institution that the relations between the size, speed, and power of marine steam-engines are not absolute and unchangeable, but that they have been continuously varying during the progress of steam navigation. In fact, we may say, that advance in marine engineering has resulted from, and been marked by, the modifications made from time to time in these relations.

The elements on which the power of any steam-engine depends are the dimensions of the cylinder, the speed at which the piston moves, and the pressure of steam employed. In general terms the power may be taken to vary as the *size* × *speed* × *pressure*. It will be seen from this, that the relations between the size, speed, and power, are directly affected by the pressure of steam at which the engine is worked.

One of the most interesting and remarkable features in the progress of steam navigation has been the successive increments in the working pressures of steam used. The rate of increase may be roughly sketched as follows:—In the few steamships that existed prior to the year 1840, the usual working pressure was 4 or 5 lbs. per square inch. Between 1840–50 tubular boilers were substituted for the old flue boilers, and the working pressures were from 10 to 15 lbs. per square inch. From 1850 to 1860 the ordinary working pressure was 20 lbs. per square inch. Between 1860–70 surface-condensing engines became general for marine purposes, and were worked, as a rule, with steam of 30 lbs. pressure. The introduction of surface condensation, by which system the boilers are fed with fresh water, enabled high steam pressures to be carried with safety in marine boilers; and since 1870 compound engines have become almost universal for steamships. These were at first worked at 60 lbs. pressure. The pressures have gradually increased from 60 to 80, 90, 100, and in some recent examples to 125 and 150 lbs. per square inch. The ordinary working steam pressure in marine boilers at the present day may be taken at from 90 to 100 lbs. per square inch, and it is probable that still higher pressures may be used before long.

The increase in the working pressure of steam has produced two effects:—

1. Reduction of the expenditure of coal; which is perhaps the more important, for this, and this alone, has rendered steam navigation, for long voyages, possible.

2. Reduction of the weight and space occupied by the machinery; this, from many points of view, especially for war-ships, is scarcely, if at all, less important than the reduction in the coal stowage.

These two divisions are so closely allied that it is somewhat difficult to deal with one without referring to the other. The subject of economy of fuel, however, important as it is, does not exactly come within the scope of the present paper; and I therefore propose to confine attention, as closely as possible, to the consideration of the reductions in size and weight of engines of a given power, that have been made, from time to time, by increasing the working pressures of steam and speeds of piston.

This is one of the principal problems with which marine engineers have to deal, and much progress has been made in its solution during recent years, and in connection with the machinery of ships intended for purposes of war. In war-ships, reduction of the space and weight required for the machinery may, in many cases, be of even more importance than reduction of coal expenditure. Although it is desirable that war-ships should be self-supporting for as long periods as possible, they are not often required to steam long distances at high speed, which is the normal condition of service in the Mercantile Marine, in which, therefore, economy of coal consumption is, of necessity, the first consideration.

In most cases, however, we shall find that the same measures that have produced economy of fuel, have also enabled the space and weight required for the engines to be reduced at the same time, particularly at the beginning of the upward rise in the steam pressures. It is however possible that we may reach a point at which the increase in working pressure, though increasing the economy of fuel, will not permit of any reduction in the space and weight required for the machinery, so that the only gain in this direction would be that due to the reduced quantity of coal required to be carried. It is also conceivable that, by-and-bye, a point may be reached at which further increase of pressure would not result practically in any reduction either in space or weight required for the machinery (including bunkers), or in the coal expenditure. I think, however, we are scarcely within measurable distance of that position yet.

The effect of the increase in the working steam pressure is to enable a given power to be obtained with a cylinder of smaller diameter, and thus to reduce the size and weight of the engines. The volumes of the steam-pipes and of the steam-spaces in the boilers may also be reduced, because the *relative volume* of the steam is decreased, that is to say, a given *weight* of steam at the higher pressures occupies less space than at the lower pressures. For example, at a pressure of 5 lbs. above the atmosphere 1 lb. of steam would occupy 19·6 cubic feet, at 20 lbs. pressure 11·6 cubic feet, at 60 lbs. 5·7 cubic feet, and

at 100 lbs. pressure only 3·8 cubic feet. The boilers, steam-pipes, &c., can be further reduced, in consequence of the collateral advantage gained by the use of high pressure steam, viz., that *less weight* per I.H.P. is required, in consequence of the more economical working of the engines. All these parts may therefore be reduced not only from the decreased *relative volume* of the steam, but also because the total weight of steam required to be generated is likewise diminished.

So far, we have referred only to the reduction in size and weight due to the increase in the working pressures of steam. This has, however, been accompanied by a considerable increase in the speeds at which the pistons of marine engines are worked, which has tended still further to reduce the weight and dimensions of the machinery. This increase of speed has, of course, to some extent resulted from the use of higher pressures; but, I think, it must be largely attributed to improvements in design, and in the details of practical workmanship. In the earlier engines it was not considered safe to work the pistons at a much higher speed than about 200 feet per minute. From an old machinery specification, dated 1845, I extract the following:—

The speed of piston for

ft.	in.					
4	0	stroke is not to exceed			196	feet per minute.
4	6	,,	,,	,,	204	,,
5	0	,,	,,	,,	210	,,
5	6	,,	,,	,,	216	,,
6	0	,,	,,	,,	222	,,
6	6	,,	,,	,,	226	,,
7	0	,,	,,	,,	231	,,
7	6	,,	,,	,,	236	,,
8	0	,,	,,	,,	240	,,

In modern marine engines of large power the piston speeds are often as high as from 600 to 700 feet per minute, and every effort is being made, by the use of improved workmanship and appliances, to increase the piston speed, with safety, to as great an extent as possible.

The relations between the size, speed, and power of marine engines may, perhaps, be most clearly illustrated by giving a brief sketch of the changes that have been introduced from time to time. In this comparison I have confined attention to the progress made in ships of the Royal Navy, for which the information is more complete and available than for the Mercantile Marine; and this will probably possess the greater interest for the members of this Institution. I think, too, we may safely state that the machinery for ships-of-war has, in all stages of the progress of steam navigation, represented the most perfect and complete type of marine engine of the day. It will, I think, be admitted, that the design of the machinery for ships of the Royal Navy has not only kept abreast of the times, but that, in many instances, it has taken the lead and initiated improvements which have considerably advanced marine engineering.

The information that can now be obtained about the earlier vessels is much less complete and exact than about the later vessels, for it is

Ship.	Date.	Maker.	Description.		Load per square inch on safety valves.	N.H.P.	I.H.P.	I.H.P. / N.H.P.	Revolutions per minute.	
			Engines.	Boilers.						No.
					lbs.					
"Rhadamanthus"	1832	Maudslay	Side-lever	Flue	4	220	400	1·8	17·5	2
"Retribution"	1842	,,	4-cylinder, vertical	,,	6	800	1,600	2	13	4
"Gladiator"	1845	Ravenhill	Vertical, direct	Tubular	11	430	1,023	2·38	15·5	2
"Terrible"	1845	Maudslay	4-cylinder, vertical	,,	9	800	1,905	2·38	15	4
"Sphinx"	1846	Penn	Oscillating	,,	7	500	1,180	2·36	16	2
"Buzzard"	1850	Ravenhill	,,	,,	20	300	834	2·78	20·5	2
"Magicienne"	1850	Penn	,,	,,	14	400	1,300	3·25	20·5	2
"Himalaya"	1854	Penn	Trunk	Lamb's patent flue	15	700	2,046	2·92	56	2
"Doris"	1857	,,	,,	Rectangular, tubular	20	800	3,005	3·75	54	2
"Galatea"	1859	,,	,,	,, ,,	22	800	3,052	3·82	56	2
"Immortalité"	1859	Maudslay	Return connecting-rod	,, ,,	20	600	2,390	3·98	55	2
"Revenge"	1859	,,	,,	,, ,,	20	800	2,548	3·18	52	2
"Victoria"	1860	,,	,,	,, ,,	22	1,000	4,403	4·4	58·4	2
"Undaunted"	1861	Ravenhill	,,	,, ,,	21·5	600	2,260	3·76	58	2
"Valiant"	1861	Maudslay	,,	,, ,,	25	800	3,348	4·18	59	2
"Black Prince"	1861	Penn	Trunk	,, ,,	24·5	1,250	5,571	4·45	54·75	2
"Agincourt"	1864	Maudslay	Return connecting-rod	,, ,,	25	1,350	5,913	4·38	53	2
"Ocean"	1864	,,	,,	,, ,,	22	1,000	4,243	4·24	58	2
"Northumberland"	1866	Penn	Trunk	,, ,,	25	1,350	6,545	4·84	47·6	2
"Crocodile"	1867	Humphrys	Horizontal, direct	,, ,,	30	700	4,044	5·77	63	2
"Hercules"	1868	Penn	Trunk	,, ,,	30	1,200	8,529	7·10	71	2
"Inconstant"	1868	,,	,,	,, ,,	30	...	7,364	...	74·5	2
"Active"	1869	Humphrys	Horizontal, direct	,, ,,	30	600	4,130	6·88	74	2
"Audacious" (twin screw)	1869	Ravenhill	Return connecting-rod	,, ,,	30	800	4,834	6·04	75	4
"Swiftsure"	1869	Maudslay	,,	,, ,,	30	800	4,913	6·14	68	2
"Volage"	1869	Penn	Trunk	,, ,,	30	600	4,530	7·55	79	2
"Invincible" (twin screw)	1870	Napier	Return connecting-rod	,, ,,	30	800	5,180	6·48	81·6	4
"Vanguard" ,,	1870	Laird	,,	,, ,,	30	800	5,384	6·73	73·9	4
"Devastation" ,,	1871	Penn	Trunk	,, ,,	30	...	6,637	...	76·8	4
"Thunderer" ,,	1872	Humphrys	Horizontal, direct	,, ,,	30	...	6,271	...	77·5	4
"Raleigh"	1873	,,	Return connecting-rod	,, ,,	30	800	6,157	7·69	74	2
"Amethyst"	1872	Rennie	Horizontal, compound	High, cylindrical	60	...	2,310	...	98·5	2
"Alexandra"	1875	Humphrys	Vertical, compound	,, ,,	60	...	8,498	...	66	6
"Dreadnought"	1875	,,	,, ,,	,, ,,	60	...	8,206	...	67·13	6
"Bacchante"	1876	Rennie	Horizontal, compound	,, ,,	70	...	5,413	...	76	3
"Inflexible"	1876	Elder	Vertical, compound	,, ,,	60	...	8,485	...	71·5	6
"Shannon"	1876	Laird	Horizontal, compound	,, ,,	70	...	3,538	...	65·5	4
"Téméraire"	1876	Humphrys	Vertical, compound	,, ,,	60	...	7,696	...	78·75	4
"Euryalus"	1877	Ravenhill	Horizontal, compound	,, ,,	70	...	5,250	...	71	3
"Iris"	1877	Maudslay	,, ,,	,, ,,	65	...	7,714	...	97	8
"Nelson"	1877	Elder	Vertical, compound	,, ,,	60	...	6,246	...	80	4
"Northampton"	1877	Penn	Vertical, composite	,, ,,	60	...	6,010	...	84	6
"Carysfort"	1878	Elder	Horizontal, compound	Low, cylindrical	60	...	2,300	...	107	3
"Cleopatra"	1878	Humphrys	,, ,,	,, ,,	60	...	2,611	...	107·9	4
"Agamemnon"	1880	Penn	Vertical, composite	High, cylindrical	60	...	6,000	...	86	6
"Polyphemus"	1882	Humphrys	Horizontal, compound	Locomotive, cylindrical	120	...	5,500	...	120	4
"Satellite" (without blast)	1882	,,	,, ,,	Low, cylindrical	90	...	1,115	...	98·5	2
"Banterer"	1880	Barrow Co.	,, ,,	,, ,,	60	...	452	...	126	2
First class torpedo-boat	1880	Thornycroft	Vertical, compound	Locomotive, cylindrical	120	...	460	...	438	2

In preparing this table I have to acknowledge my indebtedness to Messrs. Joshua Field and John Penn, who have kindly supplied me with particulars o
for much information respecting the later vessels and for per

Revolutions per minute.	Cylinders.				Pistons.		Weight.				Weight per I.H.P.				I.H.P. per		
	No.	Diameter.	Stroke.	Cubic capacity.	Speed per minute	Volume swept out per minute.	Engines.	Propellers and shafting.	Boilers and water.	Total.	Engines.	Propellers and shafting.	Boilers and water.	Total.	Cubic foot of cylinder.	Cubic foot swept out by piston.	Ton of weight.
		ins.	ft. in.	cubic ft.	feet.	cubic ft.	tons.	tons.	tons.	tons.	lbs.	lbs.	lbs.	lbs.			
17·5	2	55½	5 0	168	175	5,880	...	...	...	275	...	...	...	1,550	2·38	0·068	1·45
13	4	72	8 0	904	218	23,504	...	...	...	700	...	...	...	980	1·77	0·068	2 3
15·5	2	79¼	5 9	393	178	12,174	165	48	144	357	361	105	315	781	2·6	0·084	2·87
15	4	72	8 0	904	240	27,108	230	117	260	607	272	136	306	714	2·1	0·07	3·14
16	2	82	6 0	440	192	14,083	117	43	135	295	222	82	256	560	2·68	0·08	4·0
20·5	2	64	6 0	268	246	11,008	67	31	145	243	180	93	380	653	3·104	0·076	3·43
20·5	2	72	7 0	396	287	16,230	95	41	139	275	164	70	240	474	3·28	0·08	4·72
56	2	=77⅝	3 6	230	392	25,766	121	47	257	425	133	50	282	465	8·89	0·079	4·82
54	2	=82	4 0	293	432	31,644	143	60	341	544	106	45	254	405	10·25	0·095	5·52
56	2	=82	3 8	268	410	30,023	139	65	350	554	102	48	257	407	11·38	0·101	5·51
55	2	76	3 6	220	385	24,200	135	50	244	429	127	47	228	402	10·86	0·098	5·57
52	2	82	4 0	293	417	30,571	180	62	300	542	158	54	264	476	8·68	0·083	4·7
58·4	2	92	4 0	369	467	43,120	230	76	416	722	117	39	212	368	11·93	0·102	6·1
58	2	76	3 6	220	406	25,520	119	47	225	391	118	46	223	387	10·27	0·088	5·78
59	2	82	4 4	293	475	34,831	191	48	379	618	128	32	253	413	11·41	0·096	5·42
54·75	2	=104¾	4 0	474	438	51,903	240	97	550	887	96	38	221	355	11·75	0·107	6·28
53	2	101	4 0	445	426	47,394	291	115	564	970	110	43	213	366	11·1	0·121	6·09
58	2	96	4 0	402	464	46,646	215	78	447	740	113	41	236	390	10·55	0·09	5 73
47·6	2	=104¾	9 0	514	414	48,954	316	98	629	1,043	108	33	215	356	12·72	0·133	6·27
63	2	96	3 4	382	472	48,030	223	85	303	611	123	47	168	338	10·58	0·084	6·6
71	2	=118	4 6	684	639	97,128	445	99	547	1,091	117	26	144	287	12·47	0·088	7·8
74·5	2	=104¾	4 0	474	596	70,594	347	88	550	985	106	26	167	299	15·53	0·104	7·5
74	2	88	3 6	295	518	43,719	173	55	271	499	94	30	147	271	14·0	0·094	8·28
75	4	77	3 0	388	451	58,285	229	61	345	635	106	28	160	294	12·46	0·08	7·6
68	2	98	4 0	419	547	57,294	266	60	334	660	121	27	152	300	11·7	0·09	7·4
79	2	=86½	3 9	303	592	47,834	216	49	293	558	107	24	145	276	15·0	0·095	8·1
81·6	4	72	3 0	339	490	55,394	258	59	354	671	112	25	153	290	15·26	0·09	7·7
73·9	4	72	3 0	339	443	50,128	306	72	336	714	127	30	140	297	15·8	0·107	7·5
76·8	4	=80	3 3	455	499	69,801	334	92	456	882	113	31	154	298	14·6	0·09	7·5
77·5	4	77	3 6	453	542	70,173	370	101	504	975	132	33	180	345	13·9	0·089	6·4
74	2	100	4 6	490	665	72,496	336	88	527	951	122	32	192	346	12·55	0·08	6·5
98·5	2	1 No. 55½ 1 „ 97¼	2 9	143	542	28,184	130	27	162	319	126	26	157	309	16·15	0·082	7·24
66	6	2 No. 70 4 „ 90	4 0	707	528	93,324	497	167	656	1,320	131	44	173	348	12·02	0 09	6·4
67·13	6	2 No. 66 4 „ 90	4 6	795	604	106,739	528	128	705	1,361	144	35	192	371	10·32	0·077	6·0
76	3	1 No. 73 2 „ 92	4 0	369	608	56,179	301	60	482	843	125	28	200	353	14·7	0·096	6·4
71·5	6	2 No. 70 4 „ 90	4 0	707	572	101,100	532	112	752	1,396	140	30	198	368	12·0	0·084	6·07
65·5	4	2 No. 44 2 „ 85	4 0	315	524	41,291	242	68	334	644	153	43	211	407	11·2	0·086	5·48
78·75	4	2 No. 70 2 „ 114	3 10	537	604	84,577	426	113	664	1,203	12 4	33	193	350	14·3	0·091	6·4
71	3	1 No. 73 2 „ 93½	4 0	380	568	53,960	353	65	483	901	150	28	206	384	13·8	0·097	5·82
97	8	4 No. 41 4 „ 75	3 0	368	582	71,411	382	65	573	1,020	111	19	166	296	20·96	0·108	7·56
80	4	2 No. 60 2 „ 104	3 6	413	5	66,080	293	107	556	956	105	38	200	343	15·12	0·094	6·5
84	6	54	3 3	310	546	52,098	404	82	588	1,074	150	31	219	400	19·38	0·115	5·5
07	3	1 No. 46 2 „ 64	2 9	123	588	26,294	127	31	214	372	124	31	208	363	18·7	0·087	6·2
07·9	4	2 No. 36 2 „ 64	2 6	111·5	540	24,062	121	35	201	357	104	30	172	306	23·4	0·109	7·3
86	6	54	3 3	310	559	53,329	433	105	598	1,136	161	40	223	424	19·3	0·112	5·28
20	4	2 No. 38 2 „ 64	3 3	145	780	34,866	183	46	209	438	75	18	85	178	38·0	0·158	12·56
98·5	2	1 No. 36 1 „ 62	2 6	52	492	10,244	55	15	110	180	110	30	211	351	21·44	0·108	6·19
26	2	1 No. 28 1 „ 48	1 6	19	378	4,788	27	6	41	74	134	30	203	367	23·8	0·094	6·1
38	2	1 No. 12⅝ 1 „ 20⅝	1 0	2·4	876	2,102	4¼	¾	7¼	12¼	20·7	3·65	35·3	59·65	191·6	0·219	37·66

e with particulars of the machinery fitted in the earlier war-ships by their respective firms; and also to Mr. J. Wright, C.B., Engineer-in-Chief of the Navy, r vessels and for permission to make use of certain official records.

only within a comparatively recent period that the importance of keeping full and accurate records of all the particulars and performances of steam-vessels has been fully recognized. I have, however, endeavoured to make the comparison as full and fair as possible, and although it must be considered to some extent incomplete and approximate, I think a few useful lessons may be learnt from it. The *size* of the engine has been represented by two particulars, viz., the cubic capacity of the cylinders, and the total weight of the machinery; the former giving a measure of the dimensions of the engines themselves, independent of the boilers and appliances.

The propeller used in all the earlier steamships was invariably the paddle-wheel, and the type of engine generally employed was that known as the *side-lever* engine, which may be regarded as the marine counterpart of the beam-engine so universally used at that time for land purposes. This engine possessed the advantages of having the pistons and rods, to a great extent, balanced by the pumps and rods and connecting-rod, so that the piston was nearly in equilibrium in all positions. The great length of connecting-rod was also favourable for the transmission of the power to the crank. The engine was, however, very heavy, and occupied much space for the power developed. The boilers that supplied steam to the earlier engines were those known technically as *flue boilers*, in which the heating surface consisted of the exterior surface of a winding flue that conveyed the products of combustion from the furnaces to the funnel. These boilers were excessively heavy and cumbrous, and suitable only for very low pressures of steam.

As an illustration of this type we will take the "Rhadamanthus," which ship was fitted with side-lever engines and flue boilers, by Messrs. Maudslay, in 1832. The nominal horse-power was 220, but the engines were capable of being worked up to about 400 I.H.P., or 1·8 times the nominal power. The load on the safety valves was 4 lbs. per square inch, and the speed of piston, at full power, 175 feet per minute. The cubical capacity of the cylinders was 168 cubic feet, so that only 2·38 I.H.P. were developed per cubic foot of cylinder. The total weight of the machinery was 275 tons, 1·45 I.H.P. being obtained per ton of weight.

The next step was the introduction of *tubular* boilers, in which a series of small tubes was substituted for the large winding flue; the boilers were thus made lighter and more compact, and the working pressures of steam were increased. Attempts were also made to reduce the space and weight required for the engines by the substitution of direct-acting for side-lever engines. There were many varieties of this type, one of the earliest being the well-known double-cylinder engine, fitted by Messrs. Maudslay, in the "Terrible" and several other vessels. This engine consisted of two cylinders side by side, the piston-rods from the two cylinders being attached to a single crosshead. In order to get sufficient length of connecting-rod, the crosshead was of peculiar form and passed down between the two cylinders, having a journal at its lower end, on which one end of the connecting-rod worked, the other end being attached to the crank-pin. The engines of the

"Terrible" were completed in 1845, and were of 800 N.H.P. The I.H.P. was 1,905, or 2·38 times the nominal power. The pressure of steam in the boilers was 9 lbs. per square inch, the speed of piston 240 feet per minute, and the total weight of the machinery 607 tons. In these engines 2·1 I.H.P. were developed per cubic foot of cylinder, and 3·14 I.H.P. per ton of weight.

The simplest and most compact form of engine for paddle-wheels was attained by the introduction of the *oscillating engine*, which was adopted and perfected by the late eminent marine engineer, Mr. John Penn, with whose name this type is generally associated, though it was also used by other makers. In this engine the connecting-rod is dispensed with, and the piston-rod is connected directly to the crank-pin. The cylinders oscillate upon hollow axes or trunnions, through which the steam is admitted to, or exhausted from, the cylinders, so that the piston-rod may accommodate itself to the rotatory motion of the crank. As an example of this type we will take the "Magicienne," which ship was engined by Messrs. Penn in 1850. The pressure of steam in the boilers was 14 lbs. per square inch, piston speed 287 feet per minute, I.H.P. 1,300, and total weight of machinery 275 tons. In this engine 3·28 I.H.P. were developed per cubic foot of cylinder, and 4·72 I.H.P. per ton of weight.

The introduction of the screw-propeller for the propulsion of ships was the most important step in the progress of steam navigation. In order to obtain the same speed of ship, it was necessary to drive the screw-propeller at a much great number of revolutions than the paddle-wheel. When the screw was first introduced, it was not considered practicable to drive the pistons at a sufficiently high rate of speed to enable the engine-shaft to be connected directly to the propeller shafting, and the earlier engines used for working screw-propellers were *geared*, so that the screw-shaft was caused to revolve more rapidly than the engine-shaft. A large spur-wheel keyed on the end of the crank-shaft of the engine worked into a pinion on the screw-propeller shafting, so that the speed of the engine-shaft might be multiplied on the screw-shaft as many times as might be required. The pressures of steam and speeds of piston employed with these *geared engines* were practically the same as those of the paddle-wheel engines that immediately preceded them, so that while it is interesting to note this step it is not necessary to discuss it further.

Soon after the introduction of the screw-propeller, improvements in workmanship, appliances, and mechanical details so far advanced, that the speeds, both of piston and of revolution, could be sufficiently increased to enable the crank-shaft to be coupled directly to the screw shafting. The boilers for these screw engines were made sufficiently strong to carry higher steam pressures, and the increase both of the pressure of steam used, and of the speed at which the pistons were worked, led to a very considerable increase in the power that could be obtained within a given weight and space, and gave a great impetus to the advance of marine engineering. It is quite certain that the very powerful engines which are now so general would have been altogether impossible, had not the screw-propeller

superseded the paddle-wheel. During the period 1850–60, a number of wooden frigates and corvettes, fitted with horizontal screw engines, were added to the Navy. The engines were placed horizontally, in order to keep them below the level of the water-line, so as to be protected from the effect of shot and shell. The pressure of steam used was about 20 lbs. per square inch, and, in the majority of the better examples, the speed of piston was increased to about 400 feet per minute. In a few cases, the speeds of piston were still higher than this; the "Doris," for example, of 3,000 I.H.P., having a piston speed of 432 feet per minute, and the "Victoria," of 4,400 I.H.P., a piston speed of 467 feet per minute. The engines were all jet condensing, and very little expansion was carried out in the cylinders, so that the consumption of coal for the power obtained was high: this, however, only indirectly affects the point under consideration at present. As the average results of this type, we may take—

I.H.P. developed per cubic foot of cylinder..... =10·0
„ „ ton of weight ..... = 5·5

This will be seen to be a very considerable advance from the best examples of the slower moving paddle-wheel engines.

The engines fitted in the earlier ironclads were very similar in design to those just mentioned; but as they were of larger power, and the beam of the ship permitted a considerable increase in the length of stroke, the speeds of piston were somewhat higher, and the average results were rather better than those quoted above; as may be seen by reference to the table appended to this paper.

With the jet injection condensers fitted in the earlier ships, in which the steam was condensed by actual mixing with sea-water, the feed-water was practically as salt as the sea-water itself, and a pressure of from 20 to 25 lbs. per square inch was considered to be the highest that could be safely carried in marine boilers, in consequence of the danger that would result from scale accumulating on the heating surfaces. The general adoption of surface condensation, however, overcame this difficulty, by enabling the boilers to be fed with fresh water. In these condensers the steam is condensed by being brought in contact with the cold surfaces of a series of small tubes, through, or around which, cold sea-water is kept circulating, by the agency of a pump. There is, therefore, no admixture with the sea-water, and the fear of overheating from incrustation on the heating surfaces of the boilers is thereby removed. Since the year 1860, this system has become universal for marine purposes, and has rendered high pressures for steam navigation practicable.

When the above system was first introduced, the old flat-sided boilers, made to fit the section of the ship, were still retained. The form of shell in these boilers is obviously unfit for high pressures, but they were strengthened by fitting additional stays, &c., to enable them to carry working steam pressures of 30 to 35 lbs. per square inch, and the great majority of the war-vessels built during the years 1860–70 were fitted with surface-condensing engines, worked with steam of this pressure. The piston speeds were also considerably increased,

especially in the larger ships, in which a long stroke could be obtained. In fact, during this decade, and with this type of machinery, the speed of piston of marine engines reached a point which has only been exceeded in a few ships of recent construction. With this type of engine, the piston speeds varied from 500 to as high as 665 feet per minute. To promote economy of fuel, the cylinders were generally made very large to allow for a considerable amount of expansion at full power, and the boilers were fitted with superheaters, so that the reduction of weight was not so great as might have been anticipated from the augmentation of the piston speed. In the majority of these engines, between 13 and 14 I.H.P. were developed per cubic foot of cylinder, and about $7\frac{1}{2}$ I.H.P. per ton of weight. In some engines of this class fitted to several of the twin-screw ironclads, the speed of piston barely reached 500 feet per minute, but the other results were as given above.

We now come to the ordinary type of compound engine which has been fitted to nearly all war-ships since 1870, and which may be considered as the general type of marine steam engine of the present day. In these engines the steam from the boilers is only admitted direct to a small cylinder, usually known as the high-pressure cylinder, and at the end of the stroke in that cylinder, instead of passing at once to the condenser, the steam enters one or more additional and larger cylinders, in which the expansion is completed; after which the steam passes to the condenser. The boilers are therefore only in direct communication with the high-pressure cylinders, and the condensers with the low-pressure cylinders.

The working steam pressure in the Royal Navy with this type of engine hitherto has been from 60 to 70 lbs. per square inch. The engines now under construction are designed to be worked with steam of 90 lbs. pressure. As pointed out in the earlier part of this paper the principal object aimed at in increasing the pressure of steam has been to increase the economy of working, and the change from the ordinary surface-condensing engine, with 30 lbs. steam pressure, to the compound engine with 60 lbs. pressure, resulted in a reduction of the coal consumption per I.H.P., of between 30 and 40 per cent.

This step, however, has not been accompanied by a corresponding increase in piston speed, and decrease in dimensions and weight required per I.H.P. In fact, it must be admitted that, although the present type of compound engine is lighter than simple expansion engines worked at the same steam pressure, and with an equal amount of expansion, would be, yet the machinery as a whole is generally heavier than that of the surface-condensing engines with flat-sided boilers, worked with steam of 30 lbs. pressure which immediately preceded them, and the piston speeds are certainly no higher.

The only advantage, therefore, in point of reduction of weight and space that has been gained, as yet, by the introduction of compound engines and high-pressure boilers has been the reduction of coal-bunker space required. This is most important, but it scarcely comes within the range of the present paper, though intimately connected with it.

I will endeavour to point out the causes of this apparent check in the reduction of weight, &c., and to indicate what appears to be the most probable direction in which advance in the future is likely to take place. As a matter of course in such a case it is impossible to speak with any degree of confidence; all that can be done is to discuss the several points that push themselves forward and suggest the most reasonable and probable solution, so far as our present knowledge, experience, and judgment will guide us.

The first point that strikes us is the increased weight of the boilers. For example, compare the boilers of the "Devastation" with those of the "Nelson." The engines of both ships developed rather more than 6,000 I.H.P. The boilers of the "Devastation" are flat-sided, pressed to 30 lbs. per square inch, and, including water, weigh only 456 tons. The boilers of the "Nelson" are cylindrical, pressed to 60 lbs., and weigh 556 tons, including water. In other words, while the "Devastation's" boilers weigh 154 lbs. per I.H.P., the boilers of the "Nelson" weigh 200 lbs. per I.H.P., or 30 per cent. more. Again, compare the "Inflexible" with the "Hercules," both of which ships have engines of about the same power. The boilers of the "Hercules," loaded to 30 lbs. pressure, weigh 547 tons, or 144 lbs. per I.H.P., whilst the cylindrical boilers of the "Inflexible" weigh 752 tons, or 198 lbs. per I.H.P., which is an increase of 37½ per cent.

This increase of weight may be to some extent attributed to the increased strength necessary to carry the higher steam pressure. This, however, is insufficient to account for all the increase, for, in consequence of the more economical working of the engines, less steam is required to be generated, so that the volumes of the boilers and the areas of heating and grate surface may be made less than in the low-pressure boilers.

The principal cause of the increased weight of the boilers appears to be due to the additional thickness of plate allowed to provide against the effects of corrosion. Many of the earlier boilers, fed with water from surface-condensers, were so rapidly weakened by corrosion that they had to be renewed after having been at work for one commission only. The expense of opening out the ship to do this was so great that it was considered desirable to increase the thickness of the shell plates, to enable the boilers to be kept in the ship, without the necessity of removal, for at least two commissions.

By the introduction of steel plates and more improved systems of management, it is hoped that this difficulty will be to a great extent removed. Steel plates are more uniform in structure and much stronger than iron, so that the scantlings may be reduced for a given strength; and now that the mystery that appeared for some time to enshroud the subject of the corrosion of marine boilers has been dispelled, and the true causes of the action ascertained, it appears probable that a reduction in the *factor of safety* usually employed may be safely made. The great importance of this would result from the increase in the maximum working pressure of steam that could then be carried with the present type of marine boiler.

To illustrate this point, let us consider the case of a cylindrical boiler

10 feet in diameter, the shell of which is made of steel plates $\frac{3}{4}$ of an inch thick. The tensile strength of these plates is usually specified to be not less than 26, nor more than 30, tons per square inch. Many engineers are desirous of raising the lower limit of strength, and this may be possible before long; but for our present purpose we will take the lower limit of 26 tons, and estimate the difference in the pressures of steam that could be carried by allowing factors of safety of 8 and of 5 respectively. The strength of the joint has been taken as 0·75 of that of the solid plate.

If 8 be taken as the factor of safety, the maximum working stress allowed on the material would be one-eighth of the ultimate stress, or 7,280 lbs. per square inch. This would be produced by a working steam pressure of 68 lbs. per square inch. If, however, a factor of safety of 5 were considered to leave a sufficient margin of strength to provide for all contingencies, the maximum working stress on the material would be increased to 11,648 lbs. per square inch, which would permit a working steam-pressure of 109 lbs. per square inch to be carried. Further, if we suppose that after four or five years' work the plates were uniformly thinned by corrosion to the extent of $\frac{1}{8}$ of an inch, the factor of safety in the second case, if the original working pressure were retained, would still be 4·167, which is by many engineers considered ample; but if it were deemed desirable to retain the original margin of safety, this could be done by reducing the working pressure to 91 lbs. per square inch.

In estimating the strength of a structure like that of the shell of a boiler there are few disturbing elements, and almost exact calculation can be applied. The strength of the material used may be considered uniform, and with proper supervision during manufacture, inferior workmanship may be prevented. The most uncertain element, hitherto, has been the effect of corrosion and wear and tear, and this has caused a high factor of safety to be generally employed. Now, however, that most of the difficulties attending the boiler-corrosion question have been overcome and the methods of reducing or preventing this action have been satisfactorily ascertained, we may hope that marine boilers may retain their original strength for much longer periods than was formerly the case: and it would therefore appear that the factor of safety used for the shells of the boilers may be reduced with advantage.

The criterion of the relative strengths of the several parts is the strength they respectively possess when the boiler is worn out and unfit for further work. It is the usual practice in the Government Dockyards to burst by water pressure, for the sake of experiment, one boiler out of each set condemned, and a mass of very valuable information as to the ultimate condition of the boilers is thereby obtained. I have had, in the course of my duty, to conduct many of these bursting experiments, and, so far as my experience goes, the weakest part has, in every case, proved to be the furnace or combustion chamber, and I think it is quite safe to say that while the present form and dimensions of furnaces and combustion chambers are retained—and there appears to be no tendency to increase the

thickness of the plates in these parts—there is no necessity to use a higher factor of safety for the shells than 5. Even with this factor I believe that, when the boilers come to be worn out, the furnaces and combustion chambers will be found to be the weakest parts, notwithstanding the fact that they apparently had a much greater margin of strength than the shells, when new. It must not be forgotten, that in these parts the material is weakened to some *unknown* extent by the working and flanging at the fires during manufacture, and when the boilers are under steam, unequal and unknown strains are brought on the material by the expansion resulting from the heat of the furnaces. It is also probable that the material deteriorates from the alternate heating and cooling to which it is exposed; and corrosive action, if it occurred at all, would probably produce more effect on the heating surfaces than on the shells, which are kept at a much lower and more uniform temperature. The plates in these parts also are generally thinner than in the shells, so that the percentage of loss of strength for a given amount of corrosion would be the greater.

The present type of marine boiler is also a slow and wasteful generator of steam. Even when the draught is forced by means of the steam blast, not more than about 30 lbs. of coal can be burnt per square foot of fire-grate per hour; and only about one-half of this is utilized in evaporating the water. In many cases more than one-half of the heat that the coal is capable of evolving by complete combustion is wasted in various ways. Cylindrical boilers are even more slow and wasteful generators than the old flat-sided boilers.

In order to reduce the weight of the boiler, rapid combustion is necessary. The greater the quantity of coal that can be efficiently burned per square foot of fire-grate per hour, the smaller may the furnaces be made for a given power. In locomotive practice the rate of combustion of coal in ordinary work often reaches as high as from 80 to 100 lbs. per square foot of grate per hour, and in some cases it even exceeds this. This, combined with the smaller amount of water carried, has caused many marine engineers to look to this type as a means of reduction of weight. Mr. Thornycroft, in his fast torpedo-boats, was, I believe, the pioneer in this direction; and he forced the draught by closing the stokeholds and putting them under air pressure. The air is blown into the stokeholds by means of a rotatory fan, and a pressure of air, equal to the weight of from 3 to 6 inches of water, is easily maintained. In some experiments, made at Portsmouth, to ascertain the performance of the boiler of a first-class torpedo-boat, it was found that with an air pressure equal to 3 inches of water, 62 lbs. of coal could be burnt per square foot of grate per hour; and when the pressure was raised to 6 inches of water, the rate of combustion was increased to 96 lbs. per square foot of grate per hour.

The only ship of large size in which this plan has been adopted is the torpedo ram "Polyphemus." The machinery of this ship has been constructed by Messrs. Humphrys and Tennant, and every effort has been made to secure lightness. The engines are driven at a high speed, both of piston and of revolution. They are expected when working at full power to make about 120 revolutions

per minute and to have a piston speed of about 780 feet per minute. This will give about 38 I.H.P. per cubic foot of cylinder, and 12½ I.H.P. per ton of weight; which is a very great advance on anything yet attained with the ordinary marine engine; and the experiment is most interesting and instructive from both a scientific and practical point of view.

I do not, however, think that the locomotive type of boiler will prove itself suitable for marine purposes generally; though it may be useful in some special cases. The water spaces are too confined for general work at sea, and it would, I think, be found impossible to keep the flat sides of the fire-boxes from bulging and becoming unsafe. The great difficulty that has hitherto been experienced with these boilers, even on the trial trips, which have as yet been the only hard work to which they have been subjected in the Service, is the leakage of the tubes at the fire-box ends. This is equally true both of the torpedo-boats and of the "Polyphemus." The cause of this appears to be that the intense heat of the fire being so close to the tube-plate, causes it to expand and compress the ends of the tubes; so that, when the fires are checked, the contraction of the tube-plate leaves the tubes slack in their holes. The leakage has shown itself, in nearly every case, when the engines were eased after the full-power run, the forced draught being stopped, which reduced the temperature of the fire. The cold air, also, that enters the fire-door when it is opened, impinges directly on the hot tube-plate, without having to pass over such a length of fire as an ordinary marine boiler.

For the present working pressures of steam the ordinary type of marine boiler appears to be the most suitable; and probably little variation in its form need be made, so far as strength is concerned, for pressures up to about 150 lbs. per square inch. I doubt, however, if it would be wise to much exceed that pressure with the existing type of boiler. If pressures beyond this limit be arrived at, it will be, in my opinion, necessary to adopt some form of boiler built entirely of small tubes, to enable the steam to be generated with confidence and safety. I do not profess to indicate what type of *tubulous* boiler will prove most efficient. Those that have been tried hitherto have not given general satisfaction, but it is probable that the failures have been due more to defects in the details of construction or of management, than to causes inherent to, or inseparable from, the type of boiler. The Herreshoff coil-boiler has proved itself economical and efficient for small boats, and is the lightest type yet constructed for a given power. It is absolutely safe, but whether it is adaptable to larger powers has yet to be proved.

With the present type of marine boiler it is necessary that *artificial draught*, of some kind, should be employed for full-power working, in order to keep the dimensions within moderate limits. Until recently the steam blast was the only means used for forcing the fires. This, however, is a very wasteful way of getting steam, especially with surface-condensing engines. Other methods of forcing the draught are—

1. Fitting an exhausting fan in the funnel.

2. Blowing air into closed ashpits.
3. Blowing jets of air into the base of the funnel.
4. Blowing air into closed stokeholds.

The first plan is obviously unsuitable for ships, for the fan would require to be so large to allow all the products of combustion to pass through it, at a sufficiently high velocity, that the apparatus would be too cumbrous and unwieldy.

The blowing of air into closed ashpits is a very efficient plan, but has the objection that the pressure in the furnaces is greater than that in the stokeholds, so that, unless care be taken when opening the fire doors, accidents are liable to occur. With artificial stoking this plan would probably be found to be both economical and efficient.

The blowing of jets of air into the base of the funnel has been tested by experiment in the French Service, and favourably reported on. It is also on trial in one or two ships belonging to the French Navy; but little is known, as yet, of its practical working and efficiency.

The fourth plan, viz., blowing air into closed stokeholds, which has been adopted from the torpedo-boats, has found most favour in the Royal Navy. The stokeholds of several of the more recent ships are being arranged and fitted, so that, when working at full power, they may be closed in and kept under air pressure by means of fans.

The "Satellite," now completing at Sheerness, is the first ship in which this system has been practically tested. This ship has two independent stokeholds, in each of which there are two boilers. During a three hours' trial made on the 11th instant, with the forward stokehold closed, and kept under an air pressure equal to about one inch of water, the rate of combustion of coal per square foot of grate was raised to 39·4 lbs. per hour, and the I.H.P. developed from the two boilers was 865, or 15·7 I.H.P. per square foot of fire-grate. The average number of revolutions made by the engines per minute was 95·38. On a previous trial made on 3rd April, 1882, without artificial draught, the coal burnt per square foot of grate was 18·6 lbs. per hour, and the average I.H.P. developed with four boilers was 1,115. The effect of forcing the draught, in this case, enabled the power obtained from a given set of boilers to be increased from 558 to 865, or about 55 per cent.[1]

With respect to the engine itself, it is probable that a considerable reduction of weight could be made by the more extended application of steel in construction. Forged steel has for some time been largely used for crank and propeller shafting, piston and connecting-rods, &c., and the weights of the shafts have been further

[1] The steam trials of the "Heroine," sister ship to the "Satellite," took place at Devonport on the 30th and 31st May, 1882. On the 30th May, a six hours' run was made with natural draught only, the average power developed with four boilers being 1,127 I.H.P. On the following day a three hours' trial was made with the two forward boilers, the fires being forced by the steam blast. There were four blast nozzles used in the funnel, each $\frac{7}{16}$ inch diameter, and the average power developed with the two boilers was 695 I.H.P. By the use of the steam jet, therefore, the power of the boilers was increased from 563 to 695, or about 23¼ per cent.

reduced by making them hollow. Recently, steel castings have been used, in lieu of cast-iron, for several parts of the machinery. The pistons for the engines of the steel cruizers now under construction at Messrs. R. and J. Napier's, Glasgow, are made of cast steel, and their weight is only about one-half the weight necessary for cast-iron pistons of the same diameter. Mild steel castings of great strength and toughness, and free from blowholes, can now be made, and as the processes of manufacture are more fully developed, I think we may look forward to a considerable extension in the application of this material, which will much facilitate the reduction of weight of marine engines. The general use of *wrought* iron or steel framing for marine engines would be very costly, as it would involve a great expenditure for labour, and this system is only likely to be adopted in special cases. If, however, mild steel castings could be made, at moderate price, to supersede iron castings for the various parts, the extra expense due to increased workmanship would be avoided; and it is most probable that the material would be extensively used.

The engines of the "Nelson," designed by Mr. A. C. Kirk, now the head of the firm of Messrs. R. and J. Napier, of Glasgow, form one of the most complete examples of light wrought iron and steel framing properly and scientifically trussed and secured to the structure of the ship itself that has, as yet, been constructed.[1] The reduction in weight in this case is considerable, the engines only weighing 105 lbs. per I.H.P., while the average weight for engines of the same class, with ordinary cast-iron framing, is 140 lbs. per I.H.P., or 33 per cent. greater. Engines constructed in this manner are, however, necessarily very expensive in manufacture, as much additional labour is involved, and both the workmanship and material employed must be of the highest quality.

It is probable that a saving in weight might be effected if the framing of the engine and of the ship at the section in which the machinery is placed were considered, so far as possible, as one. As a rule the ship is only regarded as a platform to carry the machinery, and the necessary transverse strength is obtained by increasing the weight of the hull, without reference to any strength that might be obtained from the engines. In an able paper by Messrs. Read and Jenkins, of "Lloyd's Register," "On the Transverse Strains of Iron Merchant Ships," read at the recent meetings of the Institution of Naval Architects, the necessity of providing additional transverse strengthening in the engine and boiler space in steam-vessels is clearly pointed out. It would, therefore, be an advantage in the design of the engines, particularly when they are required for war-ships, in which reduction of weight is so important, if the framing could be so arranged and constructed that it would add the necessary additional transverse strength to the section of the ship, instead of being merely a dead weight to be carried by the ship.

This point was emphasized by Mr. F. C. Marshall, of Newcastle, in his paper "On the Marine Engine," read at the meetings of the

[1] See Journal, vol. xxiii, No. CI, page 614, *et seq.*

Institution of Mechanical Engineers, in August, 1881. He says:—"Great saving in weight can be effected by careful design, and by judicious selection and adaptation of materials; also by the substitution of trussed framing and a proper mode of securing the engine to the structure of the vessel, in place of the massive cast-iron bed-plates and columns of the ordinary engines of commerce." Also: "The hull and engine should be as much as possible one structure; rigidity in one place and elasticity in others is the cause of most of the accidents so costly to the shipowner. Under such conditions mass and solidity cease to be virtues, and the sooner their place is taken by careful design, and the use of the smallest weight of material (of the very best kind for the purpose) consistent with thorough efficiency, the better for all concerned."

The reduction in the weight of the engines that could be effected by improved design and workmanship, and the use of stronger material, although most important, does not, of itself, offer so large a scope for improvement as increase of speed, both of piston and of revolution. These have been highly developed by Mr. Thornycroft in the engines of the fast torpedo-boats, which at full power make about 440 revolutions per minute and have a piston speed of 880 feet per minute. The total weight of the machinery, including boilers and water, is below 60 lbs. per I.H.P. In the "Inflexible" the number of revolutions per minute was 71·5, speed of piston 572 feet per minute, and the total weight of the machinery 368 lbs. per I.H.P. Even in the "Polyphemus," in which the nearest approach to the torpedo type of machinery has been attempted, the estimated number of revolutions per minute is 120, speed of piston 780 feet per minute, and total weight of machinery 178 lbs. per I.H.P.

In pursuing this part of the subject we are met with many difficulties, arising, more especially, from the action of the propeller. The generally accepted theory of propulsion is, that the propeller produces a sternward momentum in the water on which it acts, which momentum measures the thrust exerted on the ship. The larger the quantity of water acted on, therefore, the greater will be the thrust. The usual practice has consequently been to make the diameter of the propeller as large as possible. The surface and edgewise friction of these large propellers is very great, and the large mass of water acted on in each revolution entirely precludes the engines being worked at a high speed of revolution, while they are connected direct to the present type of propeller.

From experiments made by the late Mr. Froude, it would appear that considerably more than one-half of the total energy transmitted to the propeller is wasted from various causes. It is, therefore, probable that the design of improved propelling arrangements affords a large field for invention, from which increased economy of propulsion may be reasonably anticipated in future. A large proportion of the loss of efficiency in existing screws arises from the augmented resistance of the ship from the reduction of the pressure of water under the stern produced by the propeller, so that it is very probable that improved propulsion may result, as much from some alteration in the

form of ship or in the position of the propeller, as from modification of the form and arrangement of the propeller and fittings.

The substitution of steel blades in lieu of gun-metal or cast-iron, by offering less resistance, will enable the engines to be driven somewhat faster; but a more radical change than this is needed to effect any very substantial reduction in weight and space occupied. It is probable that propellers of smaller diameters, driven at higher speeds, may be used with advantage in many cases. This was clearly shown in the "Iris," in which ship, by reducing the diameter of the screws from 18′ $6\frac{1}{2}$″ to 16′ $3\frac{1}{2}$″, the speed of the ship was increased from 16·577 knots to 18·573 knots; the I.H.P. developed by the engines being practically the same in the two trials. It would appear to be very desirable to make further experiments in this direction, especially with twin-screws, to ascertain how far reduction of diameter and increase of speed of revolution may be efficiently carried.

Mr. Thornycroft, in 1879, patented a new form of propeller, by means of which the propelling effect of a screw of given diameter is much increased. The boss is made small at the forward and large at the after end; and behind the propeller is arranged a body of peculiar form furnished with guide plates or blades, for directing the water projected by the propeller. Around the propeller and body a tube case or hollow guide is fitted, which facilitates the flow of water to the propeller, and regulates its discharge sternwards, after having been operated on by the propeller.

Mr. Thornycroft, in his reply on the discussion which followed his paper on torpedo-boats, read at the Institution of Civil Engineers, in May, 1881, stated that with his propeller, the diameter of the guide tube being 3 feet, 400 I.H.P. was utilized to the best advantage at a speed of 18 knots. Gunboats whose engines develop about 400 I.H.P. have screws generally about 9 feet in diameter. Mr. Thornycroft also calculated that two propellers, on his principle, similar to the model for the "Iris," each 7 feet in diameter, would be sufficient to use 45,000 I.H.P. at 40 knots. Of course, in these cases, the high speed of the ships would allow a full supply of water to the screws, and the statement is not altogether applicable to ships of ordinary form and speed; but it does appear to be probable that by some alteration in the form of ship or propeller, or of both, we may hope to obtain a much greater efficiency of propulsion from propellers of small diameter driven at high speeds. It is in this direction, I think, that a great scope for improvement exists. This, however, cannot be determined theoretically, and little can be done, until by a careful and extended series of experiments more definite knowledge is obtained of the whole of the conditions of the action and efficiency of propellers. It is very probable that we all have very much to learn, and possibly to unlearn, on this subject.

For the present we shall have to continue to use, with probably slight modifications in size and form, the existing screw-propeller, driven at a comparatively slow speed. It is therefore, I think, worthy of consideration whether or not it would be wise to proceed in the direction of making any material increase in the speed of engines,

to reduce their dimensions and weight, until a form of propeller adapted for high speeds of revolution has been devised. If high speed engines were used for driving the existing propellers, it would be necessary to interpose gearing to reduce the rate of revolution. This is much objected to by many engineers, but it is possible that the advantages that would be gained thereby would outweigh its disadvantages.

It is only the reversal of the process that took place when the screw-propeller was first introduced. At that time there were no engines suitable to drive it direct, and the old type had to be utilized to drive it by means of multiple gearing. This, however, gave the screw the chance of proving its efficiency, and mechanical science soon produced engines capable of driving it direct. Improvements in the screw-propeller at present appear to have almost arrived at a stand-still, so far as speed is concerned, but if gearing be admitted, the weight and space required for the engines could be materially decreased. In this case the gearing would be used to reduce the speed, and might be expected to work much more smoothly than when the reverse operation had to be performed. If the plan proved successful, we should have the satisfaction of knowing that if a high speed propeller were devised, the engines would be prepared and ready to drive it direct.

The engines of a first-class torpedo-boat, which weigh only $4\frac{1}{4}$ tons, develop 460 I.H.P., with a speed of 438 revolutions per minute. This is about the same power that is developed by the engines of the gun-boats in Her Majesty's Service. The engines of these boats, however, neglecting the boilers and propellers, weigh 27 tons, or more than six times the weight of the engines of the torpedo-boat which develop the same power. In the torpedo-boats the cylinders are $12\frac{3}{4}$ inches and $20\frac{7}{8}$ inches diameter, with a 12-inch stroke; the corresponding dimensions for the gunboat engines are—cylinders, 28 inches and 48 inches diameter, and stroke 18 inches. The speed of piston in the former case is 876 feet per minute, while in the latter it is only 378 feet. It is therefore clear, that if the gunboat engines could, with safety, be replaced by those of the torpedo-boat type, and the propeller shafting driven by means of gearing, a considerable saving of weight and space might be effected.

How far this system would be generally applicable it is difficult, if not impossible, to predict. One thing is certain, viz., that in order to enable the weights to be much further reduced, the speed must be increased. The only way of obtaining this increase of speed of the engines, with the existing form and dimensions of propeller, is to drive the propeller shafting by means of gearing, so as to reduce the speed of revolution. Whether, or not, this is desirable, and likely to increase efficiency, can only be determined by experience. The point is, in my opinion, worthy of consideration, so that its relative advantages and disadvantages may be fully discussed and thoroughly threshed out.

In order to drive engines at high speeds of revolution it is desirable that the resultant driving forces on the crank should be

made to be as nearly as possible uniform. To effect this, the *weights of the reciprocating parts* of the engines should be carefully adjusted to suit the required maximum speed, so as to cause the resulting tangential pressures on the crank-pin to vary as little as possible. It is very important that this should be carefully attended to in all high speed engines. The ordinates of the indicator diagram only give the pressures on the piston; and to obtain the corresponding pressures on the crank-pin, it is necessary to combine, with the indicator diagram, a diagram showing the work expended on the acceleration and given out during the retardation of the motion of the reciprocating parts of the engines. It is therefore clear that *strength* is not the only point that should be considered in the design of these parts; but that, if possible, their *weight* also should be so arranged that, when the engines are working at full speed, the effect of the inertia of the reciprocating parts may tend to produce uniformity in the tangential forces acting on the crank-pin. I am unable to do more than simply mention this point; which, however, is one that may make all the difference between a smoothly and quietly working engine and one whose motion is irregular.

One other point requires to be mentioned with reference to the probable increase in the working pressures of steam, which, although it primarily affects the economy of steam, is also important as regards the strains on the framing and shafting, &c. The ordinary two-cylinder compound engine, with initial steam pressure of 80 to 90 lbs. per square inch, has now practically arrived at the same position, with respect to range of expansion and temperature in each cylinder, that the simple expansion engine, with steam of 30 to 40 lbs. pressure, was in, when it was superseded by the compound engine. If, therefore, the pressures are increased beyond this limit, it will be necessary to divide the expansion of the steam into three stages in order to increase its practical efficiency, and to reduce the maximum strains on the shafting, framing, &c. This has been carried out in a few ships, one of the most recent being the steamship "Aberdeen," built by Messrs. R. and J. Napier, of Glasgow, and fitted with triple expansion engines, designed to be worked with steam at a pressure of 125 lbs. per square inch.

I cannot hope that I have done more, in this paper, than to have merely given a rapid and imperfect review of the changes that have taken place during the past 50 years in the relations between the size, speed, and power of marine engines, and to have indicated, so far as our present knowledge and experience serve as guides, what appears to be the most probable direction for future advance.

I think it will be admitted that the progress already made is great. To say nothing of the more special types of marine engines, which may perhaps be considered to some extent as experimental, we may just compare the "Rhadamanthus," mentioned in the earlier part of this paper, the engines of which ship were built in 1832, with the "Cleopatra," built in 1878. The machinery of the "Rhadamanthus" weighed 275 tons and developed 400 I.H.P. The machinery of the

"Cleopatra," which weighs 357 tons, developed at full power 2,611 I.H.P. Machinery of the "Cleopatra" type, of the same weight as that of the "Rhadamanthus," would be capable of developing 2,011 I.H.P., or five times the power of the "Rhadamanthus." It would appear from the recent trials of the "Satellite" that, with closed stokeholds under very moderate air pressure, machinery of modern design and construction would develop at least six times as much power as the earlier types of engines of equal weight.

One other feature is the great increase in the total engine power that can now be made available for the propulsion of ships. For example, take the case of the "Terrible," which represented the finest type of steam war-ship of her day. Her maximum I.H.P. was less than 2,000, and her speed about 10 knots. In the despatch vessel "Iris," two sets of engines are fitted, capable of developing 7,700 I.H.P., and of driving the ship at a speed of 18½ knots per hour. In several ships recently built, engines capable of developing 10,000 I.H.P. have been fitted.

So far as we are able to judge, the "Terrible" was as near finality in 1845 as the "Iris" and "Inflexible" are to-day. I think, therefore, we need not despair of the future, but may confidently look forward to still further progress in marine engineering. In what direction advance will be made it is, perhaps, unsafe to predict, but it does appear probable that the fields which afford the most enlarged scope for radical changes are the boilers and the propellers.

The CHAIRMAN: If any gentleman has any remarks to make or any questions to ask, we shall be happy to hear them.

Mr. PEOUNDES: It may be of interest to the members if I briefly mention some alterations that were made, some 8½ years ago, in the engines and boilers of a steamer plying in Chinese and Japanese waters; she was called the "Undine," and was built by Thomas Wingate. I shall be glad, however, to place the full particulars at the disposal of the lecturer.[1] A new propeller was fitted, the revolutions being increased from about 47 to 65 and over. Alterations were made in the engines and also in the boilers. A small cylinder was fitted inside the fore cylinder, steaming direct from the boilers as before, and exhausting into the jacket, which was thus utilized also as a reservoir. We found that having this reservoir between the non-condensing and condensing (or expansion) cylinder was of very great advantage indeed. The lecturer has omitted to mention this important matter of an intermediate reservoir.[2] The results proved eminently satisfactory, and I can vouch for the facts, the work being carried out under my own supervision, and I took the vessel some short trips before and after.[3] Better results were obtained

[1] It was originally intended to nearly double the revolutions, reducing the pitch of the propeller proportionately, and also to reduce the diameter, and by strengthening one boiler, carry higher steam, and remove the second boiler into another vessel. The alterations were carried out by Mr. Joseph Taylor, at a cost of under 1,000*l.*, with but little loss of time in laying up the ship, everything being prepared beforehand.

[2] The advantage of a reservoir, in altering engines especially, will be obvious to all experienced engineers; and another point the lecturer did not mention, was the advantage gained by the high pressure cylinder not being open to the condenser; this is one of the great points in which the compound is superior to the simple expansion system.

[3] Before altering and after altering, both light and deep trials were made, indicator diagrams, &c., obtained, and runs made over measured distances.

from one boiler than previously from both.[1] On the coast of Japan, &c., we had a very large number of vessels with engines and boilers of varying types, European and American, including many turned out by the principal English builders, furnishing special opportunities for a by no means limited experience.[2] Amongst these was a steamer originally named the "Lamont," subsequently changed to "Chili," having a very peculiar style of the American beam engine (single), placed athwartships and geared—she was built in this country. Although running at a very low speed, 18 to 22, the gearing, 1 to 3, gave great trouble. I also remember a voyage I made to Australia, in 1854, in the "Great Britain," with Penn's oscillating engines and geared. I can recall other instances from personal knowledge, and I hope that no retrogressive step will be taken in this direction, as suggested by the lecturer, especially when combined with high-speed engines. Great stress appears to be laid upon the question of mere weight, but this cannot well be reduced at the sacrifice of increased efficiency. I should be very sorry to see the cylindrical form of boiler made to give way to the older fashions, such a retrograde movement would be highly objectionable. With regard to draught, we tried many experiments on the numerous vessels of the fleet of steamers I had to do with. both by a small steam blast and other ways.[3] Following the lines of the Americans I believe would be beneficial, in larger area and increased length of funnel, for instance, the old P. and O. Company's steamer "Nepaul,"[4] by which a great increase of draught was obtained. A much larger increase in the cubic space in the combustion chamber would also be of advantage in all boilers.[5] I venture to put forward these suggestions, as I have had practical experience of so many forms of engines and boilers. I would remark, however, that I most strongly deprecate any "cold water" being thrown upon the Mercantile Marine, or the enterprise, energy, and ability of the builders of merchant ships and marine engines; the fact being (not as the lecturer infers) that nothing is to be learned whatever from the Navy, and I most certainly think they are not behind the dockyards, but on the contrary far in advance.[6] It is becoming imperative that we have some vessels of high speed, capable of carrying coal enough for all emergencies; therefore, we can look to the progress in the Mercantile Navy with advantage and learn. The lecturer does not fully detail the advantages of high steam and the compound engine. The increased skill in welding shells and furnaces, and the rolling, &c., of the plates, should not be overlooked, nor the strength of the cylindrical form and reduction of staying and weight thereby. Any attempt to fix the machinery to the hull will result in speedy injury to the hull and loosening of the rivets, leakage, &c. The engine should be absolutely self-contained, and the strains entirely between the cylinder and crank shaft bearings. We are all seeking for improved types of boilers as well as engines, and there is no limit to advance in this direction. The loss of power with large propellers is so very great, that no one can doubt the advantage of the smaller size, decrease of area, and reduction of pitch, with a higher speed, the propeller working in solid water, as deep as possible. The "Undine" alterations bear upon what the lecturer remarked about the "Iris" experiments.

Mr. SENNETT: I may say, with reference to the impression received by Mr. Pfoundes that I wished to depreciate the Mercantile Marine, that nothing was

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[1] The boilers were very long, cylindrical, with very large-sized tubes.

[2] Randolph and Elder, Humphrys and Tennant, Penn, Napier, paddle, screw, compound, &c. Wooden, composite, and iron ships, &c.

[3] A small pipe leading air into the combustion chamber produced good results in steaming, and a remarkable reduction in the density and volume of smoke.

[4] Engines by Humphrys and Tennant. Old fashion flue boilers, that gave much trouble.

[5] Some long boilers had the tubes shortened, with this object, producing favourable results.

[6] Private owners and builders are obliged to adopt improvements more promptly than a Government Department, economy in first cost, maintenance, fuel, and space, being money to them, and it is their interest to at least make a trial of every sensible suggestion offered.

further from my thoughts. In the Mercantile Marine, as a rule, weight is not of so much importance as it is in the Royal Navy. In the Royal Navy we have had to reduce the size of the boilers, and to do everything we possibly could to reduce the weight, even at the expense of getting more costly engines and perhaps boilers that do not last so long, on account of their being forced. This has necessitated the design of the engines of the Royal Navy being kept well to the front. The machinery for ships of the Royal Navy is all made by private manufacturers, and the firms that supply it are amongst the best known and the most experienced in the country; so that we have not only the ideas of people in the Service, but also have the advantage of the knowledge and experience of private manufacturers. I think Mr. Pfoundes misapprehended my statement about the boilers. I simply stated the fact that the present cylindrical boilers are heavier than the flat-sided boilers that immediately preceded them; and the reason I gave for that was, that the plates were made thicker and the boilers were made very much stronger, in order to provide against the corrosion which obtained in the early days and which was a most serious matter. I stated in my paper that for the present we are bound to retain the existing type of marine boiler. I had no idea of our going back. My reference to gearing was simply a suggestion which I think is worth discussion. In the gearing referred to by Mr. Pfoundes, a large wheel worked a small pinion, and it is a well-known fact that in such cases the irregularities in the revolution of the engine are multiplied on the shaft, so that the working would not be so smooth as if the reverse operation were performed, and the small pinion worked a large wheel, in which case the irregularities in the working of the engine would be reduced on the shaft. It is impossible to say whether this plan is feasible or not. But when we consider that the gunboat engine only develops the same power as a torpedo-boat engine and weighs six times as much, I think it is possible we may take some steps towards introducing the torpedo type of engine, at all events for war-ships. How far we can go we cannot tell without experience. At present the great draw-back is the propeller. The large propellers we use operate upon such great quantities of water that high speed of revolution is impossible while the engines are coupled directly to the propeller shafting.

The CHAIRMAN: We have only one duty to perform, and that is to return our best thanks to Mr. Sennett for his paper, which I think is full of valuable information and very suggestive in many points.

Friday, June 2, 1882.

REAR-ADMIRAL W. HORTON, C.B., in the Chair.

ON THE DEFENCE OF HARBOURS BY SUBMARINE MINES.

By Lieutenant CHARLES SLEEMAN, R.N.

IT is with the greatest diffidence that I venture to read a paper this afternoon on any component part of that vast and comparatively undeveloped subject of torpedo warfare, and most certainly should never have offered so to do, had I not received a very flattering and encouraging request from the Council of this Institution to prepare a similar paper at the end of 1879, when I was on the eve of departure for China, and therefore unable to comply, and had I not also received valuable assistance from many able authorities on torpedo matters.

The magnitude of my subject, and the short space of time at my disposal, will only allow of a mere cursory glance at most of the details of harbour defence, and but little more at those of submarine defence, which really constitutes the main feature of my paper, and it is on these latter details that I look for some clear light to be thrown by the discussion which I hope may be invoked by to-day's work.

I will here mention that, with the exception of Captain Long's lecture on "Naval Blockade," and the one on "Torpedo-Boats" by Mr. Donaldson, there has been no paper read at this Institution on any of the various branches of torpedo warfare since 1875, and only some half-a-dozen since its foundation.

The various items constituting a system of defence for harbours, river mouths, &c., may be broadly classified as follows:—

1. Fortifications.
2. Vessels of war.
3. Guard and torpedo-boats.
4. Submarine defence.

The sheer impossibility of preparing a paper which should contain an adequate treatment of each of these items, in a manner worthy to be presented to a scientific naval and military audience such as are usually gathered here, decided me not to even attempt a partial diagnosis of the first three of those items, but to devote my paper to the last but not least important of them, namely, "*Submarine defence.*"

I think it best to mention here that, on the completion of my paper, I shall, by the kind permission of Captain McEvoy, explain the manipulation of two of his many inventions, being his "Single Main System of Torpedo Defence," and his "Submarine Detector." The

inventor is a gentleman who has devoted the greater part of his life to the invention and improvement of torpedo and other military matters, and who is well known to many of you.

In discussing the subject of submarine defence, it will be best, for the sake of greater clearness, to divide it into its constituent parts; these may be defined as—

A. *Systems of fixed mines.*
B. *Locomotive torpedo submarine boats.*
C. *Submarine boats.*
D. *Passive obstructions.*

In dealing with these points, I prefer to leave that one prefixed (A) until the last, constituting as it does the main feature of submarine defence, and therefore requiring special and close attention.

I will then first treat of—

B. *Locomotive torpedo submarine boats.*—This part may be further divided into *controllable* and *uncontrollable* boats; the former class being represented by the Lay torpedo-boat, the latter by the Whitehead or fish torpedo-boat.

These representative submarine weapons being well known and time pressing, I will not attempt to describe them, nor enter into the question of their merits and demerits. With regard to the Lay torpedo-boat, I have authority for stating that it has been of late considerably improved, its speed having been greatly augmented, and its manipulation much simplified. I believe it is generally conceded that a *controllable* locomotive submarine torpedo-boat is the form best suited for the requirements of harbour defence.

Then I come to the question of—

C. *Submarine boats.*—Up to the present time no practical adaptation of this mode of progression under the sea has been wrought out, though I am told of a submarine boat now under trial in Sweden that is to be a perfect success. It is to Russia that we should look for a solution of this difficult problem; for there the matter has of late years received the closest attention, but as yet without any definite practical result. I confess to having very little faith in submarine boats ever being brought to that state of practical efficiency which is needed for the work they are intended to perform in connection with torpedo *defence*, such as the destruction of fixed mines and their cables, &c., owing to the insuperable difficulty of piercing the intense gloom of the surrounding matter, when proceeding beneath the surface of the sea. Of course if by the aid of electricity or other power this difficulty of vision be overcome, and also that of the motor for these craft to such an extent that it becomes a feasible and safe matter to start from a ship in the offing in one of these subaqueous craft, pick up the harbour entrance, and moving about at a considerable depth cut the *steel-wire* mooring ropes and *armoured* branch cables of the submarine fixed mines, then these craft will most certainly demand the bestowal of far more attention than I think they deserve as at present constructed and manœuvred. This brings me to question—

D. *Passive obstructions.*—This mode of barring a channel or other

entrance, either by the sinking of weighted ships, piles, frames, or other methods, will no doubt prove extremely useful in many instances. The action and construction of such obstructions are, I consider, sufficiently well understood as not to require any special attention in this paper.

I must here explain that the subordinate positions I have *seemingly* assigned to the foregoing particulars of submarine defence, is due to the short space of time apportioned to my paper, and not to any want of belief on my part of their *great value* under *special* circumstances.

I will now proceed with the important question of—

A. *Systems of fixed mines.*—By a system of fixed mines I intend to be understood all methods of submarine defence necessitating the employment of fixed or anchored mines, and such I consider to form the backbone and most important factor of any scheme of coast defence that may be devised; the question (A) may then be resolved into the minor ones of—

1. *Systems of self-acting fixed mines.*
2. *Systems of dependent electrical fixed mines.*

I will first treat of the systems considered under section (1); these may be subdivided into *electrical* self-acting and *mechanical* self-acting fixed mines—the former including those whose firing agent is electricity—the latter those whose firing agent is mechanism.

The special application of a system of self-acting fixed mines for coast defence purposes is that of defending certain isolated and other portions of the defensive ground, where, for economy's sake or for some other cause, it is not necessary to advert to the dependent form of defence. The one great objection to any system of self-acting fixed mines is that the ground protected by them becomes a source of danger alike to friend and foe, and also the danger that has hitherto attended the planting and picking up of such mines: as regards this latter source of danger, so strongly condemned by Major Parnell in his lecture on "Coast Fortifications," where he says—"As for mechanical mines, they are hardly worth the mentioning, and are sources of danger to their employers rather than to those they are employed against," Captain McEvoy has, by some simple yet very practical improvements, I venture to assert, almost entirely expunged this objection. Were it not for the question of economy—the bugbear of all schemes of defence—I should advocate the entire *disuse* of self-acting fixed mines, and wholly depend on the dependent electrical fixed mines for coast defence, but as this economy question cannot be ignored, then this branch of submarine defence requires the most careful consideration.

Dealing first with the question of electrical self-acting fixed mines, we notice that but very few attempts have been made to devise anything practical in this line, for the reason, that where any system of electrical mine contains within itself the power of firing its fuse, an inherent risk of premature explosion must always, in a more or less degree, be present, and this source of danger exists, though in the latter in a minor degree, in the only two inventions of this kind that claim special notice, viz., the Hertz and the McEvoy systems of

MC EVOY'S
ELECTRIC SELF ACTING MINE.

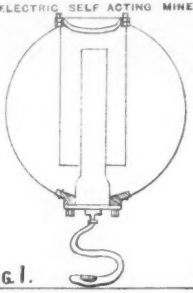


FIG. 1.

IMPROVED
BUOYANT ELECTRIC CONTACT MINE.

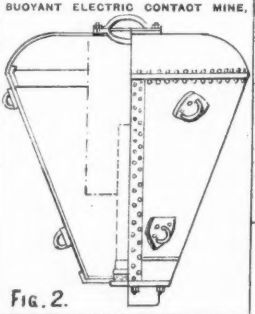


FIG. 2.

DEEP
WATER
MOORINGS.

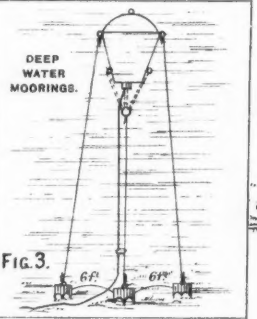


FIG. 3.

MC EVOY'S SUBMARINE DETECTOR.

FIG. 9.

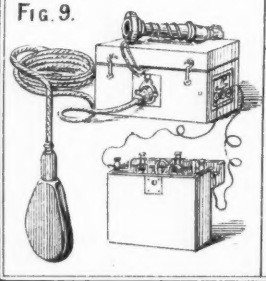


FIG. 4.

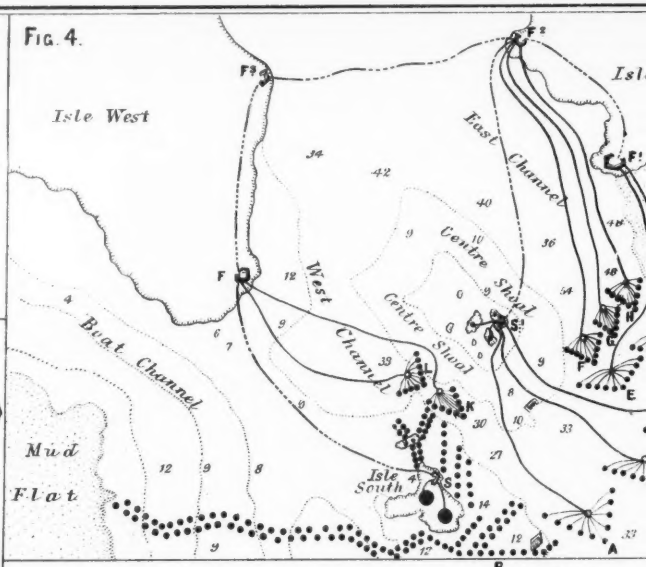


FIG. 5.

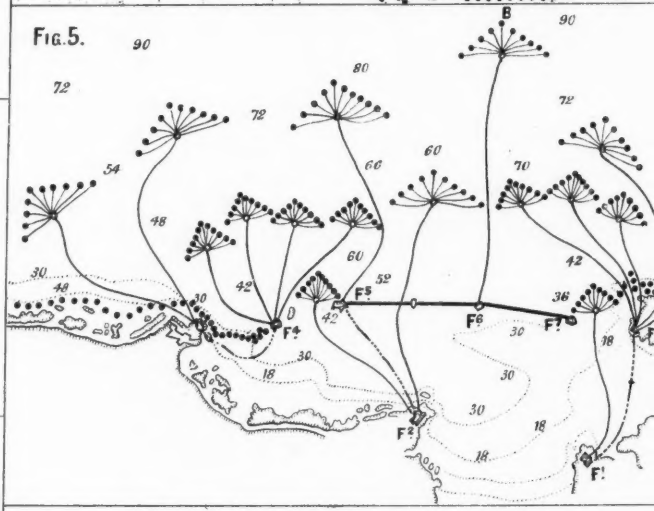
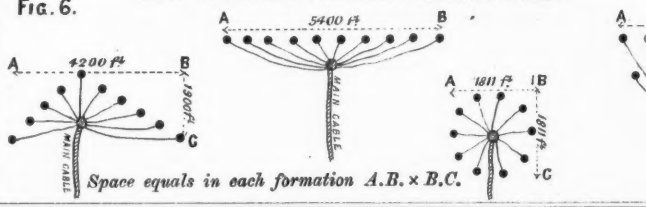


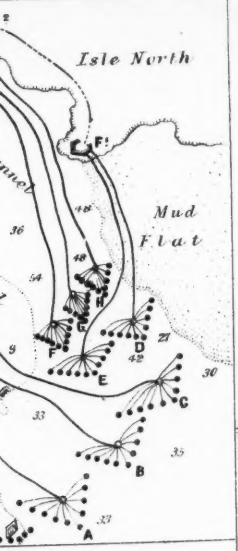
FIG. 6.

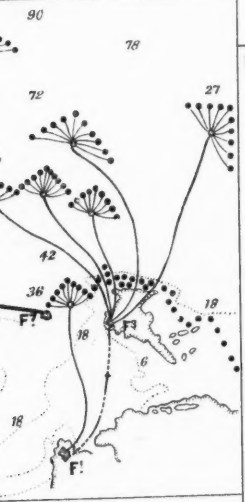
GROUP FORMATIONS FOR FIXED SUBMARINE MINES.



Space equals in each formation A.B. × B.C.

Harrison & Sons Lith. St Mart





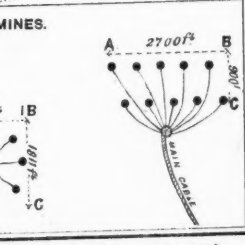


FIG. 7.

CAPT. Mc EVOY'S
SINGLE MAIN SYSTEM.

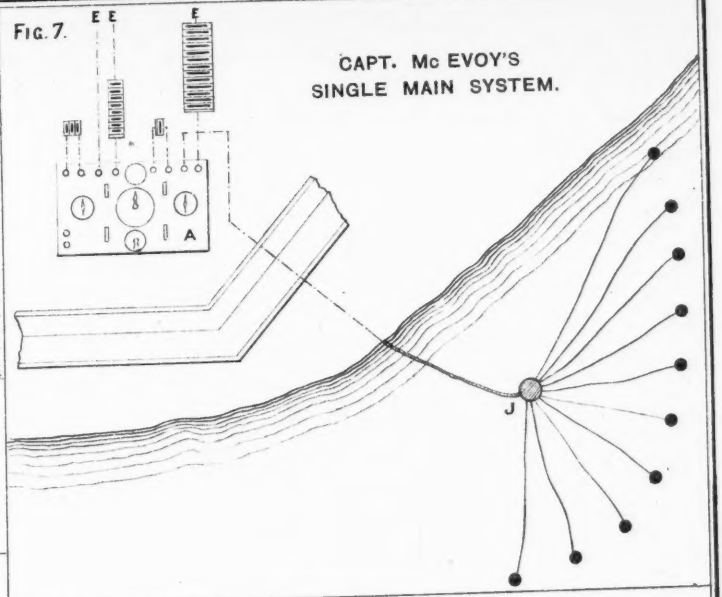
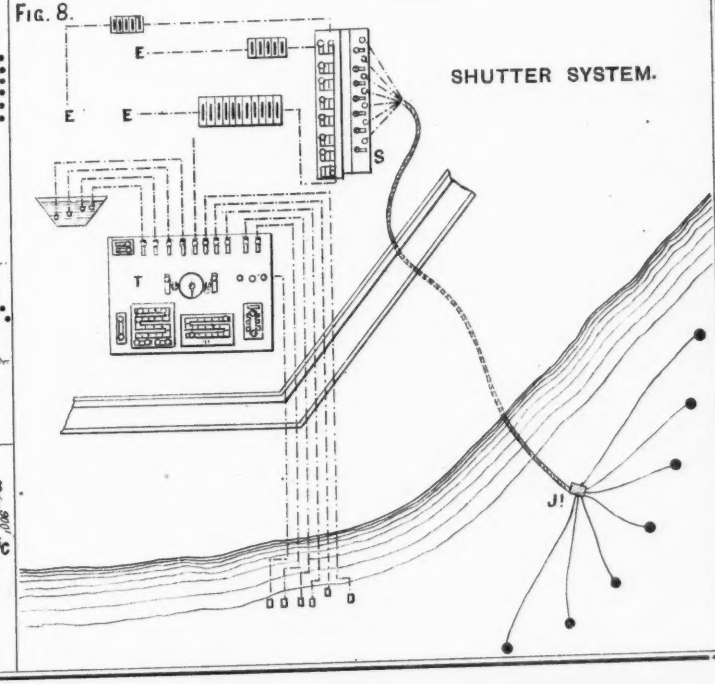


FIG. 8.

SHUTTER SYSTEM.



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electrical self-acting fixed mines. The former has been in use for some considerable time, especially by German torpedoists, and it was employed by the Russians on the Danube in 1877, when it was on one occasion successful, whilst the McEvoy system has been only lately perfected.

The Hertz system may be roughly described to consist of a mine case, on the head of which are screwed five lead cylinders, inside of these are placed five glass tubes containing chlorate of potash; beneath the lead cylinders, on the inside of the mine, are affixed five dry batteries: on either of the lead cylinders being struck by a passing vessel the glass tube is broken, and thus the battery rendered active and the mine exploded. This form of self-acting fixed mine I consider to be a most dangerous one, either to plant or to pick up; the latter fact I can vouch for, having had the unpleasant and dangerous task of clearing a part of the Danube in which some Hertz mines had been laid by the Russians. Its uncertainty I can also testify to, having seen one of the Hertz mines that had been torn from its moorings by the screw of a passing Turkish monitor, and drifted on to the bank of the river without exploding; one of its lead cylinders was considerably bent, but not sufficiently so to smash its glass tube. I was also once unwittingly anchored for some time over one of these mines, whilst on board the turret vessel "Hifsi Rahman," in company with the late Captain Manthorp, R.N., which we subsequently learnt from the Russian Officers they had attempted to explode by every means in their power, without, I am happy to say, succeeding.

Captain McEvoy's electrical self-acting fixed mine, a section of which is shown in the Plate, Fig. 1, consists of a small battery and a circuit closer placed within the mine case, also ingenious electrical arrangements for the prevention of premature explosions; as will be seen, he depends, for the action of his mine, on the contact of a hostile ship with the actual mine itself, and not with any particular excrescence. Captain McEvoy has not permitted me to exhibit this clever invention here; but I may mention that General Abbott, of the United States Torpedo Department, has ordered one of these mines for trial in America, as he considers it to be the most perfect one of its kind.

To eradicate the inherent danger I have before spoken of that exists in the ordinary electrical self-acting fixed mines, a system known by the name of the "sunken battery" was introduced. Here a set of five or more buoyant fixed mines containing circuit closers are connected with a voltaic battery, which is inclosed in a strong metal box, and sunk near its mines. This is an old idea, but it has hitherto failed, owing to the difficulty of obtaining a reliable battery; but with the present efficient state of the Leclanché this difficulty has been overcome. I will now proceed with—

Mechanical self-acting fixed mines.—Of these there are numerous and varied kinds principally devised by the Confederates, and of them the "Singer" falling weight invention has been more extensively used, and oftener successful, than any other species. Now this form of mine Captain McEvoy has taken in hand of late, and, I venture to

say, so improved it, that this mechanical self-acting fixed mine may now be considered as capable of supplying the want that has been long felt in submarine defence, namely, a mechanical self-acting mine that can be moored with perfect safety, whose action is certain, and that can be recovered with the minimum amount of risk. The original falling weight has been altered in shape and manner of resting on the head of the mine case. This new form of weight is prevented from falling off until a mine has been placed in position by a very simple mechanical contrivance; and to enable the recovery of one to be effected in perfect safety another arrangement has been introduced, whereby, though the weight may be knocked off, yet the mine will not be fired. I am not at present at liberty to divulge anything further in connection with this newly improved mine, as it has not been patented. If the proper precautions be observed when carrying out the work of recovering self-acting fixed mines, such as waiting for smooth and dead low water, employing an experienced and careful boat's crew, and also using the submarine detector, there should be no danger or difficulty whatever in picking up the "McEvoy improved Singer self-acting mine;" and this I aver with the experience I possess of such work with *unknown* self-acting mines.

I will now make some remarks on the subject of "Dumb Mines" or "Dummies." The reason originally advanced for the employment of such things was to increase the difficulties and tediousness attendant on any attempt that might be made by an enemy to clear a space protected by fixed submarine mines. Now this should most decidedly be the only duty delegated to dumb mines, instead of which there seems to be a most pernicious tendency at the present time towards the use of dummies in the place of actual mines, and to trusting the safety of a harbour entirely to moral in the place of real defence. There is no doubt a possibility of utilizing the moral effect of submarine defence for the purpose of deterring the attack of a hostile fleet, but to depend on the safety of any place by such means alone is, in my opinion, radically wrong, and is opposed to all the principles of real defensive warfare. I think it is hardly necessary to mention here, that were it England's misfortune to be drawn into a European war, then any of her opponents' harbours thus morally protected would soon fall into the hands of her fleet. This concludes my remarks on systems of self-acting fixed mines, the details of which want of time prevents me from more fully discussing; not the less, I must impress on torpedoists in general, the great importance that attaches to this branch of submarine defence; for owing to the necessity of economy, electrical dependent fixed mines will be used as sparingly as is consistent in harbour defence, and their proper places supplied by the cheap self-acting mines, or possibly by the still cheaper dummy.

I now proceed to the study of section (2):—

Systems of dependent electrical fixed mines.—Of these, under certain circumstances, four different species have hitherto been employed, namely, the "ground" and "buoyant" fixed mines, and these, combined with their circuit closers in separate buoyant cases.

The advantages claimed for any *ground* system of fixed mines are—

the practicability of employing heavy charges, no liability to damage by the contact of passing vessels, and their certainty of position always secured.

Now, though none of these advantages may be possessed by the buoyant system of fixed mines—unless it be the latter one—yet, owing to the uncertain and complicated operations attendant on the work of exploding a ground fixed mine at the exact instant of the hostile ship being within its destructive area, I prefer to depend entirely on the buoyant system for the protection of harbours by submarine defence; and I consider it most unadvisable and generally useless to employ the ground system of fixed mines. In the case of a mine charged with 500 lbs. of guncotton, and moored at its most effective depth, the radius of its destructive effect is, even with that large charge, only some 25 feet.

In the event of unforeseen circumstances rendering it impossible to use the system of buoyant mines, then I would rather trust to moral effect and self-acting mines than go to the trouble and expense of laying down a system of ground mines, necessitating the employment of any known method of observation firing, which at best can only be utilized at certain times.

I use the expression "known," for Captain Watkins, in his lecture on "Range-finders" at this Institution,[1] mentioned the invention of a position-finder, which he stated was capable of automatically connecting up and exploding ground mines within less than 9 feet of vessels, moving at a speed of from 8 to 9 knots per hour. But, notwithstanding this invention, I cannot see any necessity that could arise where aught but the buoyant system need ever be employed, and thus I propose to do away entirely with the ground system of dependent electrical fixed mines, and also with those combinations of mines and separate circuit closer cases, and by so doing to adhere to one of the fundamental principles of torpedo warfare in all its branches, viz., *simplicity*, a principle, I venture to say, far too often overlooked.

My preference for the sole adoption of simple buoyant fixed mines in any system of submarine defence by dependent mines is based on the following grounds:—

I consider *firing by contact* to be the only truly practical and effective mode of carrying out submarine warfare, possessing as it does the needful elements of success for the destruction of a vessel, namely, the delivery of the whole force of the explosion, at the right instant, and in the weakest part; and, therefore, I regard buoyant fixed mines as wholly and solely contact-fired mines. Then, following out this reasoning, I fix the maximum charge of such mines at 100 lbs. of guncotton or other explosive compound, which amount is some 40 lbs. in excess of the charge considered necessary for the contact-fired Woolwich fish torpedo.

By thus limiting the charge and making the mines contact-fired ones, I obtain for the buoyant system the following advantages:—greater certainty of destructive effect; less expense of material;

[1] See Journal, vol. xxv, No. CXIII, page 765, *et seq.*

and simplicity in placing in position, as it is unnecessary to exactly plant each mine in the actual position assigned to it, as would be the case where any system of ground dependent electrical fixed mines is employed.

A buoyant mine such as I have described is shown in Fig. 2.

Then comes the question of "mooring" buoyant mines. This has hitherto been considered a matter of great difficulty, and no doubt, under certain exceptional circumstances, would prove a troublesome business. Most of the difficulties hitherto present in effectively mooring such a mine have been to a considerable extent overcome by the employment of a steel wire mooring rope, which prevents it spinning round, and which would be found strong and pliant enough to ensure its being retained in its proper position under ordinary circumstances, the weight of the anchor having been carefully calculated according to the position of the mines, depth of water, flow of tide, &c.

In exceptional cases a mode of mooring such as is shown at Fig. 3 might be adopted with advantage.

There still remains to be devised some practical method of retaining a buoyant mine at its normal depth in places where the rise and fall of tide is very great. Mooring groups of mines at different depths, increasing with their distance from the base of operations, rectifies, to some extent, this fault, but necessitates a considerable increase in the number of mines, and therefore in the cost of the defence.

Another point in connection with the use of buoyant mines is the necessity of constructing them in such manner that they be rendered impervious to the constant ramming they would most probably receive from the passage of friendly vessels, if planted at the entrance of an important harbour; and the chances of accidents occurring from this cause must be carefully guarded against by forming them of water-tight compartments filled with cork, or some other method of rendering them unsinkable.

Having thus briefly discussed the various items of submarine defence, I will now treat the subject in its entirety; and to enable me to do this clearly and, I hope, effectively, I have prepared rough plans of a submarine defence of a river entrance and open seaport, both of which places will be probably recognized and familiar to many of my audience. I have preferred this method to the one usually adopted of creating a plan to suit the particular system of submarine defence under discussion.

Fig. 4 represents the plan of a system of submarine defence for what I term a "close" harbour, while Fig. 5 shows similarly the defence of what I term an "open" harbour. The former is of course more adapted to such a mode of defence than the latter one.

I will first take the case of the close harbour, Fig. 4. To the north is situated a large island, named Isle North, which it is impossible to circumvent by any but very light-draught boats, and therefore very simply secured from rear attack. Flanking it is an extensive mud flat.

To the west is another large island, Isle West, also secure from rear attack. Between these two islands flows a deep-water main channel, which is divided into east and west channels by the centre shoal and S[1] islands. The east channel ranges from three-quarters to a mile in breadth, the west channel from a quarter to three-quarters of a mile. Between the south-west mud flat and Isle West flows a shallow boat-channel about a mile in breadth at its widest part, but narrowing and shallowing considerably as it runs to the north. The average depth in the east channel is about 40 feet—ranging from 5 to 8 fathoms; in the west channel the mean depth is about 33 feet, whilst the depth of the shoal water to the south-west is from 13 to 3 feet, and on the centre shoal it is some 10 feet. The rise and fall of tide is about 4 feet and flows at the rate of from 2 to 4 knots per hour. The nature of the bottom is mud.

In planning the submarine defence of any harbour the points to be taken into consideration are—the object and importance of such defence, the assistance afforded by its natural formation and land defences, and the question of expense. And, going further into details, there would have to be considered—the number, position, formation, and class of the dependent electrical and self-acting fixed mines; also the question of the employment of locomotive submarine torpedo-boats.

In the particular case under review, the river, of which a sketch of the entrance is shown, leads to a most important town, possessing an arsenal and dockyard; and therefore the object of its defences, both land and submarine, would be the complete prevention of capture or of an effective blockade being established. Its natural formation lends great assistance to a work of defence, as the plan shows; and this is still further strengthened by the fact that a similar formation of narrow channels and high land is found about 10 miles further up the river, so that really the defence here treated of would only be considered as an advanced work.

First, as to the "fixed" mines themselves. The system of manipulating the dependent electrical fixed mines in this case, and also in that of the open harbour, would be the "McEvoy single main system," Fig. 7; and, taking into consideration the depth of water, rise and flow of tide, "buoyant" fixed mines of maximum power would be used, that is, those containing a charge of 100 lbs. of some explosive compound. The "self-acting" fixed mines would be McEvoy's improved Singer mine, containing only 50-lb. charges; and single moorings would be employed for both the dependent electrical and self-acting fixed mines.

Then as to their formation. By this I mean the shape or form in which the mines composing each group should be planted so as to reap the greatest advantages, such as—spreading over the largest space with greatest probability of success; simplicity in planting them and of laying out their branch cables; less chance of discovery by dragging on the part of the enemy. Now, considering carefully these points, I have preferred to adopt in the place of either circular, single line, or échelon, a triangular formation, whereby I contend the fore-

going advantages are obtained in a high degree. In Fig. 6 I have compared these four methods. The mines here are supposed to be planted at a distance of 600 feet apart, the two lines in the échelon case being 900 feet distant, which is the greatest space allowable. Then calculating the spreading area of each formation to be its length multiplied by its depth, I roughly get, taking s as the area for the triangle formation, $\frac{1}{2}\,s$ for the circular area, $\frac{1}{3}\,s$ for the échelon area, and $\frac{1}{1000}\,s$ for the single line area.

Then for the probability of success. A ship steaming on to a group of mines of the triangle formation would be almost sure to strike one or other of them, which would not be so certain in either of the other formations, unless it be the circular one.

For simplicity in planting, &c., the single line is of course the simplest, but next to it comes the triangle form.

Then as to the chances of discovery. Two or three mines of a triangle-shaped group being picked up by dragging would not afford as sure an indication of the position of the remainder as would be the case were either of the other formations resorted to.

Then as regards the number and position of fixed mines. One of the principles of submarine defence is, the prevention of serious damage to the first line of fortifications by the gun-fire of the enemy, and the forcing and retaining as long as possible under a powerful cross-fire the attacking vessels when forcing an entrance. To effect this the outer groups are planted as shown at A, B, and C, in Fig. 4. It would have been still more effective had I chosen to fortify Isle South, and consider that as the first line of land defence; but this would necessitate a great increase in the material, and consequently in the expense of the defence, so I have only treated this isle as a look-out station, and as a place capable of affording a refuge for the guard vessels and torpedo-boats of the defence. The station itself at S would be a bombproof, covered earthwork, carrying a few light guns, electric lights, &c., for the purposes of guarding and watching the outer groups of mines. And station S would be connected with fort F by the submarine telegraph cable C^1, and by this cable its mines would also be fired when requisite, to render the place useless to the enemy.

Next comes the question of the defence of the different channels. The east channel, I calculate, would require at least 50 dependent electrical fixed mines, those in each group being placed 300 feet apart. The west channel might of course be effectually and simply blocked by planting it with self-acting fixed mines, but I have preferred to utilize this passage as a mode of egress and ingress for the vessels and boats of the defence whilst carrying out their special duties. The boat channel is rendered inaccessible by self-acting fixed mines being laid down in the shoal water to the south-west. A boom obstruction, combined with some few self-acting mines, would be prepared in readiness to further block the channel at its narrowest part, on the outer defences being forced.

The main and telegraph submarine cables, of which there are thirteen, are so laid that no crossing of them occurs, and with due regard to the economy of the defence.

The shoal water round about Isle South is planted with self-acting fixed mines. These might with advantage be to a great extent supplanted by the dependent electrical system of fixed mines with 50.-lb. charges, and controlled from station S; but such would no doubt be considered too expensive.

Then we come to the subject of subaqueous batteries for the use of locomotive submarine torpedo-boats.

One battery might be placed to the south of Isle South, as at L, and its torpedoes manipulated from station S; another one, L^1, off the work at S^1, and controlled therefrom. The Germans are now experimenting with sunken batteries, containing six Whitehead uncontrollable torpedo-boats, starting them by some application of electricity; but the practical knowledge as regards the best mode of operating these subaqueous weapons has yet to be acquired, so I will not venture to further discuss them.

Having thus somewhat meagrely gone into the matter of the submarine defence of what I term a "close" harbour, I will now proceed to discuss the question of a similar mode of defence in the case of an "open" harbour, a rough sketch of which is shown in Fig. 5.

The actual harbour is comprised between forts F^1 and F, and is formed by means of a breakwater; the depth of water off the breakwater entrances, and at the outer (B) group of mines, ranges from 6 to 13 fathoms. The 5, 3, and 1 fathom lines are shown by the dotted lines. The strength of the current varies from 2 to 4 knots, and in this case a considerable rise and fall of water is met with, namely, some 20 feet at spring, and 13 feet at neap tide.

The nature of the dependent electrical fixed mines used would be buoyant ones of maximum power, and they would be specially moored somewhat after the manner shown in Fig. 3. The self-acting fixed mines would be similar to those used in the defence of the close harbour.

The distance extended by the outer line of submarine defence is upwards of 6 miles, and the groups of mines composing it are laid at some 2 miles' distance from the first line of fortifications. By the disposition of the dependent fixed mines, as shown in my plan, I hope to obtain what is the *sine quâ non* of such work, namely,—a maximum power of defence with a minimum of cost and of complication; and I cannot believe the capture of any harbour known to be so strongly fortified and supported by so powerful a submarine defence would ever be attempted, and thus the grand object of such a combination would be obtained, which is, the rendering of a port actually impregnable. The bombardment of the town and arsenals would have to be performed at a distance of 3 miles, and from seawards.

The dependent mines in this case are all planted as it were in the open sea, and thus any attempts made to damage or destroy them must be dependent on the state of the weather, and so would not be of so frequent occurrence, or stand so much chance of success, as would be the case in connection with a close harbour, where such

attempts would possess an important element of success, namely, "smooth water."

The coast about this port is an extremely rocky and dangerous one, and therefore would not require a large number of self-acting mines as a flanking defence; also the fact of their having to be moored on a sea coast would militate to some extent against their use, owing to the possibility of some of the mines breaking adrift in heavy weather. I have shown in the plan a few of these mines planted along the coast, but the actual position and number of them would have to be determined by those more thoroughly acquainted with the peculiar exigencies of the situation.

This will conclude my necessarily very few brief remarks on the subject of a submarine defence of a close and open harbour, such as I have exemplified, and the only excuse I can offer for such a concise treatment of an important subject is the vastness of the field I have attempted to cover in one short paper.

Until within the last few years, and even I believe at the present time, torpedo warfare has been looked on as something uncanny, and too terrible. Now, the primary object of submarine defence is the safeguard of a harbour against the attack of a hostile fleet, and I maintain, that in the event of an enemy's ship being sunk in any attempt to force a harbour so protected, those responsible for such service being carried out should be held accountable for any loss of life ensuing from such a catastrophe, and not those responsible for such defensive means being resorted to. As a rule, it will be generally known whether any particular harbour is studded with fixed submarine mines or not; and should the slightest doubt whatever exist as to that fact, it would in my opinion be a most foolhardy and reprehensible act on the part of any one to attempt to enter such a port.

The popular delusion as to the resultant effect of an explosion of a submarine mine in contact with a vessel-of-war still, I believe, exists, which is, that the ship is blown into the air into small pieces, with the total loss of her crew, while the actual effect with ships as at present constructed would be at the most the gradual sinking of the ship caused by a large hole being made in her double bottom, and with but few casualties to the crew, they having ample time to get clear off in her boats.

Surely this cannot be considered as uncanny, nor yet one iota as terrible as those constant and dreadful bombardments between forts and ships usually ending so seriously for the crews, which have hitherto been so common a feature of maritime warfare; but which the general adoption of submarine defence will to a great extent lessen, and thus the uncanny and too terrible torpedo may under such circumstances be looked upon as really a *life-saving* weapon.

Notwithstanding the imperfection of the systems of submarine defence used during the American Civil War, yet even then we find Admiral Dahlgreen writing: "I believe torpedoes to constitute the

most formidable of the difficulties in the way to Charleston." But though some twenty years have elapsed since those words were written, and during this period submarine defensive material has been vastly and generally improved, and that in actual war submarine defence has been proved to be of immense value, yet we find Major Parnell writing: "Submarine mines do not, however, form material obstacles, and it is probable that their value is chiefly of a moral nature."

And yet another Officer, Captain Barrington, in his work entitled "England on the Defensive," though the author to some extent appreciates the value of submarine defence, says: "But torpedoes can only destroy or cripple the first line of attack, and when they have acted, the enemy can advance without further hindrance." Also Commander Barber, U.S.N., in an article on the progress of torpedo warfare, though he looks on fixed submarine mines as of immense utility as auxiliaries to other systems of defence, yet distrusts them to a great extent, on the belief that countermining and cable cutting will often prove successful; and also the general tenor of the remarks made *à propos* of the employment of torpedoes in the discussions here and elsewhere, is to the effect that torpedo warfare cannot yet be safely relied on, and therefore need not be seriously considered in matters of attack and defence. Now all this is, I venture to say, a great and radical misconception of the real value of submarine warfare, which should most certainly be eradicated at once from the minds of all naval and military men—especially of ours—who will, in the event of war, find the at present slighted and ignored torpedo of infinite value for defensive purposes, and I fear a terrible bugbear in all naval operations.

In the event of an organized invasion of England, which to judge from the numerous articles and letters published of late from the pens of some of the ablest of our naval and military Officers, would seem to be looming in the immediate future, we should have to depend for the safeguard of our numerous harbours, ports, inlets, &c. (which number, I believe, some 280), almost entirely on submarine defence—at any rate at the outset—that being the cheapest and most ready to hand of any defensive means; and this applies not only to England, but to all countries possessing any extent of sea coast.

One of the principal objects of an invading force would be an immediate descent on some known unprotected part of our coast, and there effect a landing; but if all the numerous places that must exist in a more or less unprotected state, when land defences and the presence of a fleet only are relied upon, possess a means of submarine defence, and a trained body of men to manipulate it, then the enemy would first have to wholly or partially destroy this submarine defence, before proceeding to the work of landing, thus occasioning at least a considerable delay, and affording time for our ships to arrive, with the probable result of the failure of the invading force at that particular attempt, and possibly the utter collapse of the expedition.

I trust no misconception may arise from anything I have said as to the value and importance of our Navy; but what I have intended to

express is the absolute necessity of submarine defence to enable our splendid Navy being fully utilized, and affording it full opportunity to carry out the multifarious and onerous duties assigned to our ships at the present day, and this with perfect immunity to us from invasion.

Then, again, the vast economy of submarine defence entitles it, on that ground alone, to far greater importance and attention being paid to it than is usually the case; and, as a proof of this economy, I will mention that employing the "McEvoy single main system," Fig. 7, for the dependent electrical mines, a sum of 1,500,000*l.* would allow of a submarine defence of each of those 280 vulnerable inlets on our coasts, consisting of one-half of the whole material considered necessary for the defence of the close harbour.[1] Now this quantity may I think be taken as affording an adequate mean submarine defence for those 280 inlets.

In the method I have adopted of only employing small buoyant fixed mines in a system of submarine defence, I do not see any necessity for complicating such a system by the addition of special fixed mines, or other means for the prevention of interference with the real defence by the enemy's boats; for if, whilst attempting to damage the defensive fixed mines, one of them be struck and short circuited, I should most decidedly not hesitate to fire that particular one, with the probable effect of destroying the boats carrying out this work of destruction, or at any rate deterring a repetition of similar work. Of course by so doing it may be said that a mine is wasted, and a gap caused in the line of defence; but by the employment of the single main system and small buoyant mines I consider it quite feasible and practicable to reinforce the submarine defence at any time, even in the presence of an enemy; provided that everything requisite for the accomplishment of such has been carefully and thoroughly prepared beforehand, and the submarine defence corps have been practically trained for this special service. This brings me to the question of the organization of a submarine defence corps. With us the work is undertaken by the Royal Engineer Corps, but all the principal Continental Powers intrust the carrying out of this work to the naval Service.

Now the whole defence of any harbour must be a homogeneous work, if it be ever expected to successfully stand the crucial test of actual war, and therefore the old saying, "that those who plan the forts should also plan the torpedo defences," must be considered as only partially correct, for the resultant plan of defence of any port should be the outcome of a joint committee of naval, artillery, and engineer Officers; and the actual execution of the submarine portion of the defence should be placed entirely in the hands of the naval department; and this, I venture to say, must appear self-evident, when it is duly considered what the details of such work consists of; and how infinitely more adapted for lighter, boat, and submarine work those are who, as it may be said, are born to it, than men of the

[1] See Appendix.

shore, as to all intents and purposes military men are. I trust it may not be conceived that I underrate the value and efficiency of the Royal Engineers, than which a finer or more important corps does not exist; but I do think that the work of the sea should be performed by seamen.

Then coming to the subject of the coast defence of the British Empire—a subject of vital import, involving as it does our immunity from invasion, the power of upholding our foreign prestige, and thus the preservation of peace to the Empire now and always,—submarine defence, if carried out in a thoroughly practical and real manner, and suiting the different means adopted to the peculiar exigencies of each particular place, will assuredly prove of immense benefit by enabling us to utilize to the full the power of our Navy. Of course, the principal naval ports, such as Portsmouth, Plymouth, &c., and strategic points such as Gibraltar, Malta, Hong Kong, and others, are, or will soon be, amply provided with a means of submarine defence; but it is to the innumerable commercial ports, harbours of refuge, coaling ports, inlets, and open beaches which are to be found around our home and colonial coasts, many of which it might be absolutely requisite to securely protect, that I more particularly refer here, and in the safeguard of which submarine defence would prove of paramount importance. Captain Colomb in his Prize Essay of 1878 says—[1]

"If the enemy is to be kept at bay by a home defence of any kind, I should think that a cordon of coast torpedoes, fixed and locomotive, in the hands of a British volunteer force will do it," in which I most cordially agree with him.

A volunteer torpedo defence corps should consist principally of the seafaring population of the different ports—men thoroughly accustomed to boat work, and possessing an accurate knowledge of the characteristics of the particular place to which they belong—and thus essentially adapted to the performance of the work of submarine defence. Little or no training would be needed for the greater portion of the force, as these men would have only the comparatively simple work of laying out the main and branch cables and planting the dependent electrical and self-acting mechanical mines. Then, having ascertained the number of men at each port it is determined to defend that would be capable and available for such service, a muster of them from time to time would suffice to secure their attendance when called on. The number, condition, and power of the steam tugs, launches, and lighters available at the different ports for the work of laying down the systems of submarine defence and guarding the same would, of course, have also to be ascertained and considered. At each port a few specially instructed members of the force would be needed for the work of manipulating and fitting up the system; no highly scientific training would be needed, but actual practical knowledge of the mode of working the instruments and batteries of the particular system that it is decided to adopt would

[1] See Journal, vol. xxii, No. XCIV.

have to be thoroughly taught. The plan and mode of defence should be determined on beforehand, and all the material prepared in readiness for carrying out the same. The foregoing no doubt seems a very offhand and rough scheme of organization of a volunteer torpedo corps, but with the experience I have gained from carrying out similar work with Turkish and Chinese sailors who had had no previous training whatever, and not one of whom had ever heard of, much less seen, a torpedo, and whose language I was ignorant of, I venture to say that a scheme based on those lines would prove a practical and efficient one.

The submarine defence I would propose to adopt with such a scheme would be the simple buoyant dependent electrical fixed mine, in connection with a simple method of single main cable or rheotome system, and the McEvoy improved self-acting mechanical fixed mines. Locomotive submarine torpedo-boats, if used, should be entrusted to the regular force, and I believe a naval volunteer torpedo defence corps, carefully, and above all practically, matured, would—as an auxiliary—be to the Navy what the Volunteers are to the Army—than which no higher praise could be accorded it.

This concludes my paper, which, though it be terribly incomplete and far too concise, yet may, I hope, prove of some value in raising a discussion on the many points I have been forced to leave untouched, or only cursorily glanced at, in which, I hope, those gentlemen far more able and capable of dealing with them may join and give us the benefit of their vast knowledge and experience. I have only to beg to offer you, Admiral Horton, my most grateful thanks for your kindness in presiding, and to express the deep obligation I feel I owe to my audience for the patient endurance displayed in listening to what has unavoidably been an incomplete and dry paper, and one full of dogmatic opinions. As a result I can only hope that some of you may become imbued with the same strong opinion as myself as to the essential value and power of submarine defence.

I now proceed to describe Captain McEvoy's inventions.

I will first explain the mode of working the invention known as "The McEvoy Single Main System."

The title is intended to convey a system of submarine defence by which a number of mines are controlled and fired through a main cable of any length, but containing only one core or path for the electric current to traverse, which current enables all the various modes of firing and tests connected with any system of submarine mines to be accomplished. Hitherto, for this work, it has been necessary to use a separate core or path for each mine.

The principal object of this invention is the combination of simplicity of manipulation with great economy.

The single main and multiple main systems are shown and compared in the Plate, where Fig. 7 represents the former, A being the shore instrument and J the junction box, inside of which is placed the sea or rheotome instrument; and Fig. 8 represents the latter, T being the test-table, S the shutter arrangement, and J′ the junction box.

The advantage of the former method over the latter in point of simplicity and paucity of connections is obvious from the plate, being as 1 to 2; and this advantage is still more patent when we take the case of the connections in a torpedo-room from which a number of mines—say fifty—are controlled. In this instance, using the McEvoy system, there would be only 5 main cable and 35 other connections, giving a total of 40. While using the multiple cable system there would be 7 main cables, necessitating 49 connections, which, with the 63 other wires, makes a total of 112, or as 3 to 1 in favour of the McEvoy system.

Then another advantageous feature of this method is that due to the lightness per mile of its main cable, weighing as it does one-third less than the multiple main cable per mile, thus making the laying-out of such a work far more handy, requiring less time, and less expense; further, the gain in economy by the use of the McEvoy system owing to the extreme comparative cheapness, namely, as 1 to 4, of its main cable, which constitutes the chief item of expense in submarine defence, is yet another very important feature to be considered; and in the matter of the foregoing points of vantage on the side of the McEvoy invention, no one, however biased or prejudiced, can take exception thereto.

Before explaining the mode of manipulating this invention, it will be necessary to state, in general terms, the requirements of a perfect single main cable system:—

1st. Its manipulation must be simple and practical, and not requiring the services of a skilled electrician.

2nd. It must be certain in all its actions.

3rd. It must be capable of firing either at will or by contact.

4th. It must be able to denote the electrical state of each mine by comprehensible and easy tests at any time.

5th. It must afford certain indications of any severing or damage of either main or branch cables.

6th. It must denote the number of any mine exploded or struck.

7th. It must afford indication of the sinking of any mine.

8th. There must be no possibility of a switch or key being left in its wrong position.

[*Note.*—Then followed a general explanation of the system.]

Having thus shown you the capabilities of this invention, I will mention, and I hope overrule, the few objections that might be preferred against it. The sea instrument is of course the main objective point:—

1st. It may be thought to be too delicate an instrument to be placed under water, and in a position difficult of access, and on which the working of ten submarine mines depends.

Twenty or even ten years ago these objections might have been made with some show of reason; but nowadays, with the practical knowledge that we have of the satisfactory working of intricate pieces of mechanism under an excessive strain—such as telegraph and other instruments—no one would think of entertaining any objection to the adoption of an electrical instrument solely on account of its

apparent delicacy of construction. I say apparent, for it can be only so to those who are unaccustomed to manipulate such instruments. Now, this sea or rheotome instrument of Captain McEvoy's, which is a very much simplified adaptation of the Wheatstone A B C telegraph instrument, would, on actual service, have to stand comparatively little work—probably not more than four series of tests each day. This instrument, and a similar one I had with me in China, have been often subjected in one day to far more work than would be the case with one of them on actual service in the course of a month's ordinary work; and yet we have never had occasion to remove the lid of the instrument case, for repairs or other matters, though this and the one used in China have been hard at work for many months.

Next, as to its being placed under water. This is, I venture to say, a very simple matter, involving merely the construction of two separate brass boxes, or more if it be considered necessary, one inside the other, both watertight, and capable of resisting a pressure of water, varying according to the depth at which it would be placed, a work, with the present perfection of all mechanical details, easily and practically attainable.

2nd. It might be thought that owing to electrical leakage the balance may not work satisfactorily, and therefore uncertain tests afforded, after a group of submarine mines has been planted for any considerable length of time. Now, this fault caused by leakage, which I have greatly exaggerated, would be easily remedied by merely increasing the power of the signal battery, by the addition of a cell or two: for the failure of the signal current, which is supposed to be kept at a normal strength, to correctly swing the test needle, is due to its current, or a portion of it short circuiting through the points of leakage.

This completes the explanation of this clever invention, which has been adopted by several foreign Governments, and I trust I have most favourably impressed you with its power and practical usefulness for submarine defence; any way, I believe you will concur with me in declaring that it deserves a fair and honest trial.

Captain McEvoy supplied one of his original sets of these instruments to the Chatham torpedo authorities in 1879, but so far, he has not had the satisfaction of receiving an expression of opinion as to the merits or demerits of his invention; the Chatham set does not embrace all the late improvements.

This particular set of Captain McEvoy's system is adapted for a group of 10 fixed mines. Now, it has been often urged that this is too great a number of mines to be manipulated by one set of instruments and dependent on one main cable, and that also a far too large gap would be formed by the loss of one such group through the discovery of its main cable by the enemy.

Take the case of the close harbour in Fig. 4—here 100 dependent fixed mines are estimated for its defence, necessitating 10 sets of instruments, and 10 main cables. If only 7 mines compose each group, then to obtain a similar defence there would be required 14 sets of instruments and 14 main cables; and in the case of 5 mine

groups, 20 sets of instruments and 20 main cables would have to be employed, and I do not think the exponents of the reduced group system would consider the advantages claimed for it to be attained by the use of a greater number than 5 mines for each group: then by substituting the reduced or 5 mine group system for the 10 mine system, it is evident that far greater time is required for the work of laying out the defence, the cost is nearly double, and the simplicity of the work much impaired by the increased number of main cables and instruments; also the chances in favour of a main cable being discovered by the enemy are exactly doubled, therefore, weighing carefully the advantages and disadvantages of the two systems, I think it will be generally agreed that the 10 mine group system is by far the preferable one.

In conclusion, I will proceed to explain the very latest of Captain McEvoy's inventions. It is termed a "submarine detector," Fig. 9. It is constructed on the principle of the induction balance, and consists of an instrument box, small battery (which may be either a magneto or ordinary chemical battery), and the detector with its cable and box: this detector cable is composed of four insulated cores, and by an ingenious contrivance, the connection of these four cores can be made or broken by one movement. Within the instrument box is placed a set of induction coils, and a vibratory magneto-electric apparatus, the telephone in connection with which can also be laid in the box; the battery poles are always connected up, but the circuit can be broken or closed at will, by means of a small key; within the detector itself is placed a set of induction coils. The action of this invention is as follows:—the circuit being closed, and the telephone placed to the ear, a very distinct and regular increase of a humming sound will be heard on the near approach of the detector to any piece of metal however small, culminating on actual contact therewith. This invention, as may be easily understood, will prove of great value in an infinite variety of ways; as specially connected with submarine defence, it will be found of great use in discovering the position of submarine fixed mines—both dependent electrical and self-acting—also junction boxes, cables, &c., when it is required to recover the same.

APPENDIX.

The following is the amount of material that would be required for a submarine defence similar to that of the close harbour, Fig. 4, where Captain McEvoy's system of defence is employed:—

10 sets of { Shore instruments.
Sea ,,
Junction boxes.

100 buoyant dependent electrical mines.
100 relay circuit closers.
100 anchors.
½ mile of steel wire mooring rope.
22·44 miles of armoured cable for the 10 *main* cables.

20·5 miles of armoured cable for the 100 *branch* cables.
22·44 miles of steel wire rope for the 10 junction box tripping ropes.
24 10-cell Leclanché batteries.
4 Leclanché firing batteries.
139 self-acting mechanical mines.
139 anchors.
¼ of a mile of steel wire mooring rope.
7·34 miles of cable for 3 submarine telegraph cables.

The CHAIRMAN: There are gentlemen present who can tell us something of torpedo arrangements: perhaps some of them will be kind enough to make observations on the interesting lecture which Lieutenant Sleeman has given us.

Captain CURTIS, R.N.: I have seen and heard more about torpedoes here than in all my life. Lieutenant Sleeman will excuse me if I try to touch upon the weak points of his paper as they appear to me. I conclude that these are not the most awful weapons that they are generally supposed to be. Admiral Horton, no doubt, recollects Captain Spratt, who, during the Crimean War, sounded in shore at Sebastopol when the Russians fired at him repeatedly. It appears to me, that naval men should be the men to lay down torpedoes, and also to pick them up, being paid prize money for them when picked up before the enemy. Artillery men may say where they require them to be laid for the protection of a fort, but as a naval man, I consider that everything that has to do with the sea, seamen should be told off for. If Captain Spratt had been at that time a torpedo Officer, and it had been his duty to use this detector, I have no doubt he would have cut off the main cable. We would run the risk of that. Then, again, at one point the ground mines appear to me to be superior to the floating mines, inasmuch as six or seven years ago I wrote to Captain Morgan Singer and suggested the idea of picking up the floating torpedoes. My idea was taken from the antennæ or feelers of a lobster. They are spars 50 feet long or so, with jaws of steel. One is a fixture and the other arranged scissors-like, attached to a capstan, and you have a net over the jaws; and if you say the destructive effect of a torpedo is only 25 feet of area, you may easily have the beam 35 feet across your bows, and I presume we should have vessels whose special duty it would be to precede the vessels attacking the fort to cut off the junction. Of course, if the torpedoes went off when they came up in the net some of the apparatus would be damaged; we should have several spare spars, &c., but that is a matter of little consequence, I imagine. You were speaking about torpedoes being moored at five or six miles off the fort. No doubt they would be detected with these detectors. Then, I think, there would be no difficulty in picking them up in detail. That is where I see the weak point of torpedoes, and I think the torpedo that goes off by coming in contact with a ship is certainly superior to any others.[1]

Colonel MALCOLM, R.E.: I came here to learn, not to talk, and I alone represent the Army side of the business, because, unfortunately, at the present moment the Royal Engineers are occupied with their meeting, which takes place only once a year, which I have run away from. I can only say that we have been working in the Army pretty hard for the last twelve years, to my certain knowledge. We do not find torpedo defence quite such a simple thing as it appears on the table, and we do trust to a not inconsiderable extent to that moral power which the lecturer scorns, while he confesses to its influence, when he says, "In my opinion it would be a most foolhardy and reprehensible act to attack a fort without a great deal of care." He also referred to Odessa, where people, to be brought through a series of what we have every reason to believe, as he said himself, were chiefly dummies, were stopped seven miles outside and passed in blindfolded. But how would that act at Liverpool, or in the great port of London? The business of torpedo work is very simple on paper, but it is not quite so simple when you have got to deal with the interests of this little island, which is so intensely commercial. I just throw

[1] NOTE.—That nation who has command of the sea, can lock his enemy up in his own port, by countermining with torpedoes, &c.

this question out, because, of course, we are very glad of any hints, and I have received some valuable hints myself to-day. I am in a position more or less confidential, and I do not quite know what I may say and what I may not; but taking the defence of these 280 inlets at 1½ millions of money, if we give them twenty more, and make 300 of them, it comes to 50,000*l.* per inlet, or 50*l.* each mine. What does that represent? Does that represent the mine cable, the mine cable and apparatus, the mine cable, apparatus, rooms, and boats, &c.? There are so many things that I am afraid that must be rather a *couleur de rose* estimate. As an old lecturer at Woolwich used to say, "Gentlemen, this is a large subject." Many points that have been shown here are not new, although they are so very pretty. The ability to render a number of mines active or inactive at will, for instance. With regard to what is called Captain McEvoy's single main system, I do not know from what year he dates it, but I myself propounded an exactly similar system as far back at least as the year 1872, of course with the very same objects that Captain McEvoy seems to have very successfully accomplished. We worked it for seven mines to a great extent; we could put 49 mines on one cable, but we found so many practical difficulties that do not appear on the lecture table, that the seven mines on the single core system have been given up. Captain McEvoy's rheotome system, we have been told, has been tried at Chatham, but as it is not the latest pattern according to the lecturer, certain defects have been discovered, so, although it is very highly thought of, it is not perfect enough to give complete satisfaction there. As for mechanical mines, of course we lay very great stress and importance upon them. There has been the very greatest difficulty in getting a mechanical mine to do all you want. You have to get a thing that will go off if you look at it, and that is perfectly safe to handle. That is not an article very easy to obtain, but there are certain mines at present under consideration and observation not mentioned by the lecturer which promise well, and it takes some time when you have got to deal with great pecuniary interests to settle upon patterns; because it is not only this country, but we have Colonial possessions, and so forth, to be looked after. We must satisfy ourselves to some degree. We are custodians of the public money, though we get little credit for it, and we must satisfy ourselves we have got a good thing. This cannot be done off-hand. Still, although we have been some years unsuccessful at it, we think we see light at last towards solving the problem, that difficult one of getting a satisfactory mechanical mine. To criticize a little, in that open coast system of defence, there is a very large opening between two and three, through which launches might go, and I fancy the whole of that upper line would be cut without the slightest trouble by the gentlemen from Portsmouth. That is supposed to be 13 or 14 fathoms. But in many places at that distance from land you get a far greater depth of water, then mooring your mines becomes a greater difficulty, and a three-fold mooring must be, I think, useless. There is one thing I am thankful to find, that there has been so good an attendance, and I hope Lieutenant Sleeman will succeed in impressing on the public the importance of submarine defence, in which, both actual and moral, I do believe firmly, and if we can get more money, I hope we shall be able to get on faster than we have done in the years that are past.

Lieutenant SLEEMAN: First, I will reply to Captain Curtis. He seems to think the weak spot of submarine defence is the fact that it is an easy matter to pick up and cut a main cable. Now, in all our principal naval ports and strategic points, such as Malta, Gibraltar, &c., and also our principal Colonial ports, it would be of very little use laying down a system of defence, unless that system were protected by guard vessels and boats; then it should be an almost impossible work for the attacking boats to get into a harbour and damage its submarine defence in the face of the guard boats and vessels, the guns of the forts, electric lights, &c. No main cable has in actual war ever been successfully got at and cut, though I think during some torpedo experiments at Spithead the attacking force did accomplish it, but that was what the Chinese call "play pidgeon" only. If you lay down mines, as you might have to do, in harbours where there were no land defences or guard vessels, you would simply place them there to prevent the enemy's vessels getting in, on the spec of there being no submarine defence; and also it would cause considerable delay and great trouble to pick the submarine mines up; for even in peace

time, and with every appliance to do such work, it is very troublesome and tedious. Now, I had to pick up self-acting mines at Sulina, on the Danube, during the Russo-Turkish War of 1877–78, that I knew nothing of, not having seen the kind before—it was the Hertz mine. The first mine was found in a boat all ready for mooring. As I knew nothing of its manipulation, I had to set to work and take it to pieces, all the time expecting a premature explosion by clock-work apparatus or otherwise. Having diagnosed the mine, we set to work dragging, and though my boat's crew were composed of Turkish sailors, whose language I knew not, and who had never before seen a torpedo, and were in mortal fear of the mere name, yet five of these self-acting mines were safely picked up. I mention this to show that under the most untoward circumstances it is not so very difficult a feat to pick up self-acting mines in *your own water*, and so I maintain that with Captain McEvoy's self-acting mechanical mine it would be perfectly easy and safe to lay down and pick up any number of them, by men accustomed to sea work. But it must be remembered that an attacking force would not be attempting to pick up mines, cut cables, &c., in harbours familiar to them, but in strange ports, which probably may never have been visited by them before, by which the difficulties of such a work are enormously increased. In the Turkish War it was found extremely difficult *even* to pick up the entrance to a harbour. Colonel Malcolm seems to believe a great deal in moral effect. Now, moral effect would be important no doubt, for the trouble would be to distinguish between a moral and a real defence, and a harbour might be entered which was thought to be only *morally* defended, instead of which it might be possessed of a real submarine defence, and the consequence of such a mistake would be somewhat serious to the attacking ships. I know the case of a harbour in the Black Sea about which the opposite supposition was accepted, that is, it was believed to be defended by torpedoes. Now, the late Manthorp Bey, not crediting this report, proceeded in one of the small Turkish monitors, and steamed round this harbour at a speed of eight knots, without exploding a torpedo, a pretty conclusive proof of the absence of any submarine defence there. Had his ship been blown up, not having taken any precautions to clear the harbour, he would have deserved hanging. The result of this bold manœuvre was, that the Turks would not believe that such things as Russian torpedoes existed anywhere; and thus it came about that the Turkish monitor, "Hifsi Rahman," was anchored for some time over a Russian mine, as I have mentioned in my paper. Manthorp Bey, who was in charge, laughed at the idea of there being any Russian torpedoes in the Sulina branch of the Danube. Then, notwithstanding the fact of a Russian boat with a self-acting mine in it having been captured just previous to the Russian bombardment of Sulina, the Turkish Admiral ordered a steam-tug and gunboat to proceed up the river and reconnoitre the enemy's fleet, the result being the destruction of the gunboat by one of these very same self-acting mines. The tug at the time of the catastrophe was some two miles in advance of the gunboat, but observing the explosion at once returned to Sulina, and left that same night for Varna with the wounded, it being impossible to induce the Admiral to send her up the river again for the purposes of reconnoitring, which would have been perfectly safe, as the Russian torpedoes were evidently self-acting ones, and moored at a greater distance from the surface than the draught of water of the tug, which was only some four feet. I mention this fact as a proof of the moral power of actual submarine defence, and how simple a matter it is to raise a torpedo funk. Colonel Malcolm also asked as to the expense of submarine defence. Of course in calculating the sum of one million and a half of money for the defence of the 280 ports, &c.,[1] I have not gone into the question of the expense of the labour, boats, &c., but I have calculated the cost of the actual torpedo material used for my close harbour, where 10 sets of instruments, 100 electrical dependent mines, 100 circuit closers and anchors, 22 miles of main cable, &c., are required, which would give a total of 10,114*l.*; and with 139 self-acting mechanical mines, &c., a sum of 13,467*l.*; then taking half of the foregoing material for each of the 280 ports, and allowing a certain percentage for the large quantity, I obtain the sum of one and a-half million before mentioned,

[1] See Appendix.

which I think is a very fair estimate. In conclusion, I beg to thank you for your kind attention, and Admiral Horton for his acceptance of the chair at the last moment.

The CHAIRMAN: We have had a very interesting lecture, and heard opinions expressed from both the sea and the land, from the attack and the defence sides of the question. I fear that one conclusion must be arrived at in which all here will concur, that it is an enormously expensive system to deal with. Colonel Malcolm knows more appreciatively the expenditure involved in it, and certainly there appears the advantage in the system advocated by Lieutenant Sleeman and Captain McEvoy, of economy in the use of a less amount of material; but the men, the stations, the boats, must remain the same. At every station there must be a very large investment of capital employed, and whether we shall ever arrive at a satisfactory solution of the torpedo question is a matter which time can only solve. I was myself concerned in the initiation of the system, I forget how many years ago. In the year 1864 or 1865, I think, we began a Committee of Investigation, and as yet the thing is in the air. Lieutenant Sleeman has told us of certain experiences of his which do not appear to have been successful. Further than that, I fear I have very few remarks to make of any sort; but that he shows us a step in advance, I think we shall all be prepared to admit. I had the pleasure of meeting Captain McEvoy, whom I knew many years ago, in the hall, and he told me this searcher is his latest invention. It seems extremely ingenious, simple, and practicable, but beyond that, I do not know that we have had put before us much that is new, except the simplicity of having one cable instead of a return circuit. I do not know the mechanism of the circuit closer, and that I fear we shall not have explained to us. I need not detain you further than to return our thanks to Lieutenant Sleeman.

Captain McEVOY: It has been at his own wish and desire that Lieutenant Sleeman has done me the honour to prefer my torpedo systems to others, and I am very much indebted to him, and beg to thank him for it, and in regard to which I feel fully prepared to verify all the statements he has made as to the comparative efficiency and economy of my systems over others. I think we are all indebted to him for his interesting paper. My main object in rising was to say that it occurred to me that his explanation of some of the questions asked was not clearly understood as regards the application of this instrument to the permission to friendly vessels to pass over the mines at night. The apparatus is particularly applicable to that purpose, when it is set simply to give signals. It may again be set, so that the mines may fire themselves. It is arranged again that any mine may be picked out separately from all the others, and fired by observation. When it is set for signalling only, any vessel may pass over with perfect safety, the firing being left to the will of the operator. I should like to say a few words in regard to the submarine detector. It is based on the principle of the induction balance—Professor Hughes' more recent application of it, or rather discoveries in connection with it. The application is new for the purpose to which it is applied, and I have endeavoured to put it into the most practical shape for practical work. It occurs to me it ought to be very useful for many purposes on board ship, such as recovering lost anchors, discovering the position of submarine cables, and more particularly the locations of submarine mines. Or, it may be used to discover treasure or sunken vessels, and for the assistance of divers in muddy waters, and many other purposes.

The CHAIRMAN: I would ask whether it could possibly be of any use in coming across a cable, because there would require to be some exposed metal.

Captain McEVOY: Any insulated metallic substance can be instantly discovered. The principle is this. There are two circuits, one the primary, the other the secondary, and in this sinker or sounder there are two coils of wire, and in the box there are two coils. When it touches any metallic substance the balance is destroyed, and instantly there is a rumbling noise in the telephone.

Friday, June 30, 1882.

VICE-ADMIRAL H. BOYS, Member of Council, in the Chair.

NAVAL BRIGADES.

By Captain H. J. FLETCHER CAMPBELL, C.B., R.N.

The CHAIRMAN: I have much pleasure in introducing to you Captain Campbell, who is going to read to us a very interesting paper. I will not make any remarks at present, further than to say that I do not think any person in the Service is in a better position to write a paper on the subject of Naval Brigades.

THE term Naval Brigade is applied to the crews of two or more ships brigaded together for service on shore; it cannot be correctly applied to the crew of any one ship; this should be designated as a Detachment of the Naval Brigade; the same rule would apply to portions of the brigade when detached from the main force.

The term "Officer Commanding" should only be applied to the Officer in chief command of the brigade, whether present or not.

Naval forces have frequently been employed on shore in conjunction with the military; they co-operated in the wars in America, and in the early part of the century five hundred seamen and marines assisted at a successful attack on the Dutch intrenched camp in the island of Java; later on, over three thousand men assisted at the siege of Sebastopol; in the Indian Mutiny, in the Abyssinian and Ashantee Expeditions, as well as in China, New Zealand, and South Africa, the Navy has contributed its share to swell the aggregate of the imperial forces.

The force should, if possible, be organized before leaving the ship, and the more perfectly and completely this is done, the more easy will it be to maintain discipline and order when the time for landing arrives.

Two complete changes of clothing are required by all, and should, with other necessaries, be carried in a black bag; one bag being allowed between every three men, or three bags to a tent.

The head-dress for Officers and men may be the uniform cap with cover, and in warm climates, curtains to shade the head and neck; light sun helmets might be used if they can be got, but the men do not like them, and they work much better in their caps.

Officers should wear a single-breasted pea-jacket, with stand-up collar buttoning close up to the throat, and having distinguishing lace on the sleeves; the men should wear serge jumpers and trousers. All should be provided with leggings coming well above the calf of the leg so that they cannot slip down when wet; ankle gaiters may look very well on parade, but they are quite useless on active service when

men are liable to be wet for days together, and where they have to ford rivers on the line of march.

Officers and men should be provided with a military great coat, and it would be well to make application as early as possible to the Commissariat in order that a sufficient number of these may be available, also one or two blankets and a waterproof sheet; the sheet should be used to lie on at night and the blanket should be wrapped in it when on the march.

If possible, military boots should also be provided, as the naval boot soon wears out when used on shore; a white working dress is also most useful, and should be taken if the transport will admit of it.

It should be noted that all white articles of dress should be dyed some dark colour, as when white they form a most conspicuous mark for the enemy's riflemen, and can be seen in the distance or in the bush, when a dark-coloured article of dress might have permitted the wearer to remain unobserved; in the fight with the Zulus at Inyezane the blue-jackets were in white with white helmets, and to this may be attributed the great number wounded, nearly ten per cent. of those engaged.

The white clothing was afterwards dyed brown, and this renders it less easily discerned than even the jet-black bodies of the natives themselves.

Officers should be provided with either a small uniform tin case or a black ship's bag, anything that can keep out the wet being the principal object; those who are mounted should, if the campaign is to be of any duration, provide themselves with cord breeches, as nothing in the shape of cloth will stand constant wear in the saddle.

As few non-combatants as possible should be landed, but an armourer and shoemaker are indispensable. No Paymaster's Staff or Police are required, but the principal medical Officer should take such of his staff as he may require; the senior Officer from each ship should be furnished with lists showing the amount which may be paid monthly to each person, and lists of all sums so paid, as well as of all clothing issued, or other charges incurred, should be forwarded to the ship as opportunities occur. All payments must be made on account only, and in round sums; the fair accounts being kept in the ship's office.

Every man should be armed with a rifle. I unhesitatingly condemn the idea of landing men in war armed with swords and pistols, and the idea of taking them into action so armed should not be entertained for a moment. Every Officer should carry a revolver of improved pattern, which should always be with him; it may be carried in a holster attached to the sword-belt.

The sword-bayonet is an arm that might well be improved; it is unnecessarily heavy, being seven ounces heavier than that carried by the Royal Marine Artillery. It is most inconvenient in skirmishing, as a man cannot kneel without using one hand to look after it; and the large clumsy handle is extremely inconvenient when marching, as it interferes greatly with the working of the arm; such as it is, however, a young signalman of the "Active" defended himself with one, so I have

been told, at Isandula, killing four Zulus before being himself assegaid in the back by a savage who crept under the wagon against which he was standing. Still, as single-handed encounters with the sword are rare in these days, I think a light bayonet would be a good substitute.

Men are usually required to carry seventy rounds of ammunition in their pouches, but it must be remembered that in skirmishing or when moving at the double, if the pouches have been opened, single cartridges or even packets are liable to fall out; many are lost in this way, and, unless pouches are made deeper, I see no remedy, as in the heat of action few will stop to button their pouches.

It is very important that arrangements should be made for the supply of spare ammunition in action, as with breech-loaders seventy rounds are soon expended. Men must be specially detailed for this duty, which may be well intrusted to kroomen in ships carrying them; they might also be employed to carry wounded men to the rear, as no person must be permitted on any account to leave the ranks for this purpose.

The men should be divided into companies of fifty each, with a proper proportion of Officers; the Officer in charge of the company being held responsible for his men in every respect, on duty or off duty. The company should be divided into tents in the proportion of five to each; there must be a leading man in each tent who will be held responsible for it and for the conduct of its inmates; each tent and all gear appertaining to it must be numbered.

A proportion of entrenching tools should be issued to each tent. In encamping, the companies' tents should be pitched in line, with the Officer's tent, of which there may be one to each company, in rear, or at one end.

The tent of the Officer in command should occupy a central position and invariably have a distinguishing flag flying, so that orderlies and others may know where to find the headquarters of the corps, or at least where to lodge their communications.

The Royal Marines should be similarly divided, and form separate companies. It occasionally happens that seamen and marines are ordered on detached service, and while the latter are under the Naval Discipline Act, one Officer must be in command of the whole: it seems to me not only unjust but unadvisable that an Officer of the Royal Marines when on shore should take command after a naval Officer, who may be, and very probably is, very much younger and less experienced. I therefore advocate the rule that all Officers, whether naval or marine, should take command according to *seniority*. This arrangement would, I think, be of great advantage to the efficiency of the Service.

The strictest discipline should be maintained, and uniformity of dress insisted on; a general inspection in the forenoon, the same as on board; every punishment awarded should be entered in the defaulters' book, and the men made to understand that any misconduct will be duly recorded against them.

Summary punishments are easily made applicable to service on shore. Extra work of all sorts is plentiful about camp, and defaulters

should be called upon at all times, the oftener the better, for any job which may turn up. Almost the first thing done in a military camp in the morning is to sound "defaulters fall in," a custom which is well worthy of imitation; cleaning and making latrines is also their special province, indeed, there is no lack of means for punishment, and I venture to think corporal punishment is not required; it was only once inflicted during over eight months' service in Zululand, and then on a stoker for possessing himself of a bottle of brandy from a sutler's wagon.

Should any irregularity occur in a tent, all that has to be done is to have it struck the first thing every morning and kept down all day; this operation repeated, will soon bring the inmates to order. Of course the limits of the camp must be defined, and no one allowed to pass them without permission. A public-house should invariably be put "out-of-bounds," and have sentries over it, who should allow no one to pass without a written order from his Commanding Officer.

Spirits are rarely issued to the troops, at most twice a week, and sometimes not at all; to stop this great treat is a punishment which I am sure is severely felt.

Soluble cocoa should always be provided for issue in the mornings as an extra ration and independent of the allowance of provisions.

Temporary arm-racks should be fitted round the tent-poles and rifles kept in them ready for immediate use, two sticks tied to the poles, like crosstrees, will answer the purpose.

A tent should be considered much the same as a mess on board ship. Each should have a cook of the mess, who should not be required to perform any other duty; unless a whole company is required for duty, a tent should be the unit for any work, except guards, the men for which should be taken from a general roster of the whole force; men having been on guard for twenty-four hours should not be called on for duty until a similar time has elapsed after their having been relieved.

In selecting a camping ground three points have to be chiefly considered, viz., a clear view all round, so that no one can approach unseen, and ready access to wood and water.

Having pitched the tents, select a place for the kitchen, and let the cooks prepare to light fires while the remainder are constructing the usual entrenchments, detail parties for fetching wood and water, tell off a "guard" and have a guard-tent pitched a little separated from the general camp.

If unaccompanied by cavalry, picquets must be thrown out, and sentries placed on commanding positions round the camp.

Sentries must be placed on the drinking water, and care taken that if it is a running stream no washing is permitted or animals taken to water above the drinking places. It is advisable to select places for both these purposes, and to have notices posted showing were men are to wash and animals to drink.

A place for latrines should also be selected and pits dug; separate ones for Officers and men: and it should be generally understood that these are the only places to be used. Indiscriminate littering about a

camp is most objectionable if the stay is only for one night, while if more prolonged, it becomes an intolerable nuisance.

These details would be arranged by the Quartermaster-General's Department if with an army, but if detached, would be the duty of the naval staff Officer.

The principal medical Officer should consider it a special part of his duty to bring to the notice of the Officer commanding any defect he may observe in the sanitary arrangements of the camp; he should cause the water in the vicinity of the camp to be examined with a view of prohibiting the use of any which he may find likely to be detrimental to health, and of suggesting that which he may consider most desirable for drinking purposes.

It is too late to think of drill when a campaign has commenced. There is always as much other work to do as can be done; it is therefore of the utmost importance that this should be attended to beforehand.

To be a good rifle shot is perhaps the first requisite, and this can only be attained by careful tuition at a rifle range, under the superintendence of the Officers of the company, and to be cool and steady in firing is of equal importance.

Nearly all movements are conducted in fours; it is therefore of the utmost importance that men should be thoroughly drilled into forming line either to the "front," "rear," right, or left from that formation, so as to be brought face to face with the enemy in the shortest possible time, as in wars with uncivilized nationalities all their attacks partake of the nature of a surprise, and if immediately met and checked are seldom pushed further. I know one commanding Officer who, when escorting a convoy, marched half his men "right" and the other half "left" in front, so that "front" would bring them to face outwards, on whichever side of the wagons they were marching.

The system of "attack and defence," as laid down in the Field Exercise Book, should be constantly practised, and in attacking, the advance conducted with supports and reserves. During the fight at Inyezane, on the advance to Echowe, a Zulu position was attacked, and the final assault led by the blue-jackets of H.M.S. "Active," who had been well grounded in the system of attack prescribed in this book. It must be understood that to attack an enemy in position without supports and reserves should rarely be attempted, and only as a *dernier ressort*, as if unsuccessful, it will surely lead to repulse and disaster.

Perhaps the most arduous duty of a campaign is that of a "picquet" at night, and Officers would do well to study the "Soldier's Pocket-Book" on this and other subjects connected with a soldier's duty while on active service in the field. The picquet should have clear instructions what to do in case of attack, how and where they are to retreat on the main body, as if they rush in anyhow, they are liable to be received as enemies, and perish on the bayonets of their comrades.

The system of encamping in the Zulu war was first to form an enclosed space by packing the wagons in a circle, to place in this

enclosure all the horses and cattle, and to construct a trench outside the wagons, and four to five yards from them, which was manned by the fighting men of the force, guns being placed in position. At eight o'clock every evening the force was mustered at the alarm posts, and each man lay down in his place fully accoutred with his rifle beside him, and so passed the night. About one hundred and fifty yards in advance of the trench the picquets were placed, with their sentries slightly further advanced, so that a complete circle of posts was established round the camp. Tents were rarely used in presence of the enemy, as it was found that men could not get out of them quickly enough in case of an alarm at night.

I do not propose to enter into an account of the history of Naval Brigades generally, but shall confine myself to making a few observations on the one with which I was personally connected.

This force consisted of 40 Officers and over 800 men, with an armament of 2 12-pr. Armstrong guns, 4 field guns, 5 Gatlings, and 6 24-pr. rocket tubes; in addition to these, in the early part of the campaign there were 2 7-pr. mountain guns.

The 9-pr. guns were drawn by 8 oxen, and for each gun there were 2 carts drawn by 6 oxen each, and containing together 160 rounds of spare ammunition.

Each rocket-tube had 1 cart drawn by 6 oxen for itself and rockets.

Each mule carried in bags 1,500 rounds of spare Martini-Henry ammunition.

Mules are to be preferred to oxen for guns if they can be obtained.

Ships' limbers are not generally fitted for being drawn by animals; it is therefore necessary to have shafts fitted, if horses or mules are to be used, and a dissel-boom if oxen.

A stand is also required for rocket-tubes, and may be constructed like a tripod of light iron.

The Officer in command of the brigade was assisted by an experienced Gunnery Lieutenant, styled "Staff Officer," who performed the duties of Adjutant.

All official communications with the Army passed through the Staff Office, and none were permitted through any other channel, and no official communication was held with any but the recognized staff of the Army.

The Naval Officers and seamen were equally divided into two divisions, called right and left wings; to distinguish them from the Army divisions, the Royal Marines and Royal Marine Artillery formed a third and distinct division under their own Officers.

Ships' companies were kept as much as possible together; in this case it happened that the crews of "Boadicea" and "Active" about equalled the crew of the "Shah," therefore the latter composed one wing under the commander of their ship, while the former formed the other wing under the commander of "Boadicea."

The artillery was equally divided between the two wings, taking care to keep similar guns together, so as to avoid confusion with the ammunition.

The principal medical Officer had entire charge of the Medical Department, having hospital tents and means of transport, independent of the other portions of the brigade. Those who became sick and unfit for duty passed into the charge of the Medical Department, remaining so until again fit for duty, being, while sick, entirely separated from their companies.

The means of transport is a most important part of the Service, and an active Officer, who must be mounted, should be specially detailed for this duty. All baggage animals, and those used for drawing guns or wagons, as well as their drivers and conductors, should be under his charge, and he should be in constant communication with the Transport Department of the Army. Some idea may be formed of the work cut out for this Officer when I state that, at the final advance into Zululand, the number of animals attached to the Naval Brigade at one time exceeded four hundred.

It is out of the question that guns can be dragged by men on a march, or spare ammunition be carried by them; they should be reserved in all their strength and vigour for fighting purposes, and taken into action as fresh as circumstances will admit.

Mules carrying fifteen hundred rounds of spare rifle ammunition were attached to each company, and always accompanied it.

The following were the regulation weights carried by different vehicles:—

Description of vehicle.	Drawn by	Regulation load.
Wagon	16 oxen	3,000 lbs.
Cart	6 mules	1,000 ,,

The amount of spare ammunition accompanying the Army was 80 rounds in regimental wagons, and 50 rounds in the ammunition column, making, with 70 rounds carried by the men, 200 rounds in all.

Considering the question of transport, I cannot think 24-pr. rockets a desirable weapon to accompany an army on the march, although they may be used with advantage in fortified positions. The weight of 50 rockets and 2 tubes would be about that of a field gun, and 30 shell, or of no less than 12,000 rounds of rifle ammunition. This rocket is more calculated to frighten than hurt, although I once saw it used with signal effect against a kraal occupied by the Zulus, crashing through the fence, and scattering the defenders in fine style, but there is no reason why a field gun should not have done the same thing.

The Gatlings were used at Inyezane and Gingilhovo with considerable success, and no difficulty whatever was found in the working of the machinery connected with them.

I will now attempt a description of the method adopted to transport Colonel Pearson's column across the Tugela River, as it was a work entirely designed and executed by the Navy.

At the place selected, the river was 200 yards broad, and although easily crossed by a pontoon, or by wading up to the armpits in dry weather, became quite impassable when swollen by the rains which commonly prevailed at the season, remaining in this state several days at a time. Obviously some plan must be arranged which would

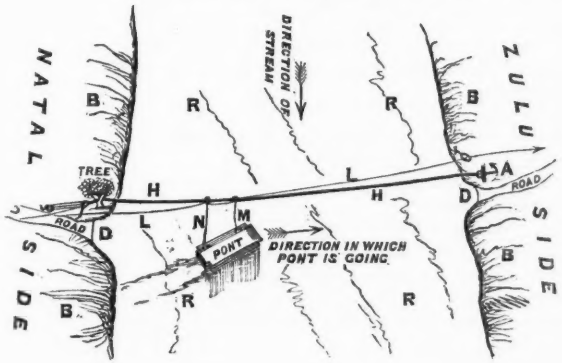
enable the Army with all its stores, and something like 200 wagons, to cross on the day appointed, whatever the state of the river, and one which would also secure constant communication between the two sides of the river during the continuance of the campaign, for the purpose of forwarding supplies and reinforcements.

Two systems were proposed; one was to place an anchor in mid stream, considerably above where it was desired to effect the crossing, and to carry a rope from it to the pontoon, which was to swing from side to side, pivoted as it were on this anchor, and aided by ropes from each bank, as occasion required.

Another plan was the one which was adopted and was found to work successfully for several months, sometimes night and day, until the water became too shallow for the pontoon to float, and until many bridges had arrived from England.

A wire 5-inch hawser was stretched across the river, and secured on one side to an anchor deeply buried in the bank, and on the other set up by a purchase, after being passed over the fork of a large tree to keep it out of the water; it could thus be tautened or slackened at pleasure. The hawser was run through two iron thimbles, allowed to travel along its entire length, long lizards being spliced into them, which were secured to bollards in the pontoon; hauling lines were attached to the thimbles close up to the hawser and carried to each bank of the river, by means of which the pontoon was pulled from one side of the river to the other, small docks being cut in each bank to receive it.

SKETCH PLAN OF PONT CROSSING TUGELA.



A. Anchor.
H. H. Wire hawser.
L. L. Hauling lines.
R. R. River.
B. B. River bank.
D. D. Small docks to receive pont.
M, N. Lizards, which can be lengthened or shortened at pleasure.
D × D. 200 yards.

In the first instance the hauling lines were worked by men, but afterwards the work was well and easily done by oxen.

To illustrate the dangerous nature of this river after rains, I may mention that shortly before the day appointed for the passage of the Army, the hawser had been got across, the pontoon tried, and all pronounced ready, when in one night the river rose and swept the whole away, dragging a 9 cwt. anchor out of the bank where it was buried, into the middle of the river.

To underrun the wire hawser, detach it from the anchor, and lay it out again, was a work of no small difficulty and danger, and such was the velocity of the stream, that during this operation several men were swept from the pontoon into the river, where one lost his life, and the others escaped with difficulty.

In a General Order, Sir Charles Pearson alluded to the conduct of two seamen who endeavoured to save the life of their comrade, as "an act of bravery deserving to be publicly noticed," and continues, "most of the Officers and men were at the Drift yesterday, and know with what dangerous rapidity the river was flowing."

So strong was the stream that it was with the utmost difficulty hauling lines could be got across the river: indeed the only way this was accomplished was by mooring a boat in the centre of the river and running the lines from her to each bank, all attempts to take the lines direct across failed, the boats carrying them being swept down the stream.

Of course iron blocks would have been better than thimbles to travel along the hawser, but none suitable were to be had; the thimbles soon wore out and had to be frequently replaced, especially when the stream was strong and the friction great.

Later on, came the work of establishing a landing place on the Zulu Coast, where there is nothing in any way approaching a harbour, or even a sheltered place.

A spot was selected called Durnford, where the beach was sandy and clear of outlying rocks, but exposed to the full force of wind and swell from the South Indian Ocean.

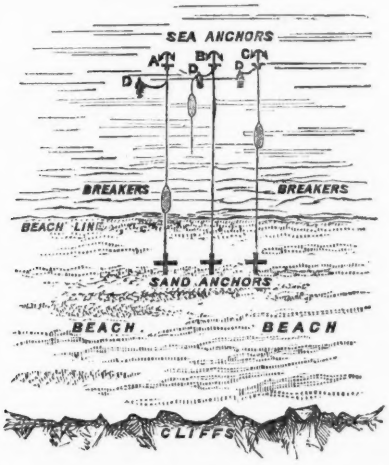
Cargo boats were procured specially for the purpose, and men hired to work them trained for this particular service by long experience of the dangerous bars of the East African Coast. The boats were those ordinarily used for passing through the surf on this coast; they were capable of being closely battened down as the water frequently broke over them; they were fitted with strong timber heads at bow and stern, through which the hawser worked.

Three anchors were laid out, outside where the surf was breaking, and strong hawsers carried from each of them through the surf to the beach, and there secured to sand anchors, buried above high water mark; the hawsers were buoyed inside the sea anchors, and the cargo boats brought to these buoys by a steam tug when loaded. They then picked up the bight of the hawser, passed it into the places prepared for it in the bow and stern, and slipped along it to the beach, where men were in readiness to remove the freight.

The ships anchored about $1\frac{1}{2}$ miles off the shore, and remained com-

fortable enough while the weather was fine, but had to put to sea when the breakers got up. A large quantity of stores were safely

LANDING AT DURNFORD.



B. Shows lighter waiting to pass through surf.
C. On the way in.
A. Unloading.
D. Buoys.

landed in this way, and sick men embarked, in fact it had the effect of transferring the base of operations from Durban to within a few miles of the Army itself.

Of course the men unloading the cargo boats had to work in the water. This duty fell on the Navy, whose province it is to deposit stores on the beach; but although the men were working in their flannels every alternate day from daylight to dark, no serious sickness occurred therefrom, indeed it seemed to agree with them much better than digging trenches, which seemed always detrimental to health. It is, I believe, generally allowed that constantly turning up fresh ground which contains decayed vegetable matter, is very liable to generate fever, and it is still worse if men have to sleep on ground thus newly exposed to the action of the air. This is one reason why I advocate the waterproof sheet being slept on, instead of being used as a covering.

The greater part of the Naval Brigade embarked here in July, 1879, having been landed over eight months; it had taken an active part in the war throughout, having been largely represented at the actions of Inyezane and Gingilhovo, and at the defence of Echowe, and was not unrepresented at Isandula and Ulundi. Its services were thus acknowledged by the different military commanders, viz.:

Lord Chelmsford himself came to Simon's Bay, and visited the different ships, and highly complimented their crews for the work they had rendered during the war.

General Crealock wrote: "I cannot part without thanking the Naval Brigade for their valuable assistance in bringing the campaign to an end, and last, but not least, for their good work on the beach at Durnford."

Sir Charles Pearson wrote: "The good services they performed were most conspicuous."

Sir Garnet Wolseley, after reviewing the Naval Brigade previous to embarkation, handed the Officer in command an order of the day, in which he expressed his very high appreciation of the services it had rendered while acting on shore, stating that the conduct of all had been admirable, and their bearing in action worthy of the Service to which they belonged; and that in returning to their ships they would have the satisfaction of knowing that all recollections of the Zulu war would be ever associated with the Naval Brigade, which had borne so distinguished a part in it.

I cannot conclude this paper without a word of sympathy and regret for my old comrade Commander Romilly and his gallant companions who fell in the Transvaal.

The CHAIRMAN: If any gentleman would like to offer any remarks on Captain Campbell's paper, we shall be glad to hear him, or if he wishes to put any questions with reference to the subject before us, I am sure that Captain Campbell will be very glad to answer them.

Captain VERNEY, R.N.: I am sure we must all thank Captain Campbell for his paper, and for the exhaustive manner in which he has dealt with the subject. I should think that no naval Officer would care in future to land men without making himself acquainted with the paper. Captain Campbell's account of the way in which they crossed the river was very interesting. I have seen in America the way in which they cross a river by means of a hawser, and I daresay many gentlemen know there is no necessity for hauling a vessel across, but by keeping her a little askew of the stream, the action of the water gets her across. You haul in the bow or stern hawsers, and she is carried across by the action of the stream. I should like to ask Captain Campbell whether that was not the case. The only reason for hauling that occurred to me was that it was owing to the thimbles not travelling with sufficient facility, because in America they have blocks which travel. I commanded a party of men landed in British Columbia; we were away from the ship three weeks or a month, and we were all day long crossing and recrossing a rapid stream by means of a hawser, and there was never any question of hauling the pontoon across, because the action of the stream always carried the pontoon across. But we had every facility, and were not above 10 or 12 miles away from the ship, so that we could get all we wanted. I am sure that everyone who heard the paper must feel that it shows a great deal of knowledge of the subject which Captain Campbell has brought before us, and it contains a vast amount of valuable information which one only gets from a practical man who has carried out the work with so much distinction as Captain Campbell has.

Commander W. F. S. MANN: One point in the interesting paper we have just heard seems to me very important. Captain Campbell said, "When the time for action arrives training must cease." I quite agree in that, and should like to hear from Captain Campbell whether he considered the Officers and men under his command, during the operations in question, were sufficiently well trained for fighting on shore. I have had some experience with a Naval Brigade, and believe that men-of-war's men, as a general rule, are good enough. A large number have been, and

continue to be, thoroughly trained in the gunnery ships, while the remainder receive some training in ships in commission, it being obligatory that they should be trained, to a certain extent, for service on shore. But it does not appear that such requirements are obligatory for the Officers, many of whom are not conversant with what their men have been taught; consequently, it is only those who have passed through the gunnery ships, and become great authorities on so-called gunnery matters, who know how to handle men on shore. I speak with deference before older men, but it seems to me that many of the senior Officers do not keep up such knowledge—if ever attained—so that when a Naval Brigade or detachment has to be landed for service, the command—the practical command—has often to be given to a much younger Officer than ought to be appointed; probably to a so-called Gunnery Lieutenant, because no senior Officer present "knows the drill." I am of opinion that to prepare for shore fighting, both Officers and men should be trained on shore.[1] If it is clearly acknowledged that men-of-war's men are to be prepared to take part in land operations, they should be trained beforehand to do so efficiently—their value would then be great. At present under the existing system —or want of it—I do not think we are in as fit state for fighting on shore as we easily might be made to do.

The CHAIRMAN: I should like to ask Captain Campbell one or two questions with regard to detail. He has given us a very interesting description of the brigade to which he belonged, and his views of the necessity of Naval Brigades generally. He mentioned, as a matter of detail, that Officers and men should be provided with leggings, "coming well above the calf of the leg, so that they cannot slip down when wet." I want to know what description of material he recommends for those leggings or gaiters, for the information of Officers in future, so that we may know what is the best material. Then, he says, "as few non-combatants as possible should be landed." Now, Captain Campbell has not mentioned, except in the encounter with the Zulus, the signalmen. No doubt he had some signalmen with him. Perhaps he will tell us—first, how they should be armed, and, secondly, as to the necessity of their duties in the field, and the implements they employed for signalling purposes,—whether they used banners or flags or semaphores. Then, he says, "the sword-bayonet is an arm that might well be improved." I agree with him there, but we must bear this in mind. This question has been considered before; it was not passed over, and the sword-bayonet was adopted in its present form and size to correspond with the cutlass, because, though on land the bayonet may be preferable, the primary duties of seamen are afloat, and it was thought that the short sword-bayonet, which corresponds with the cutlass, was better adapted for boarding or boat service than the bayonet. I quite know the objection he speaks of in skirmishing. Men have to keep fidgeting about to keep the sword from between their legs, and it is a great inconvenience to them; but on the whole, for naval service, I think the sword-bayonet is the better weapon of the two. Another point that I should like to ask about is the accoutrements. Within the last two or three years new sets of accoutrements have been approved for the Navy. I should like to know whether any of these were issued to Captain Campbell's men, and if so, if he could suggest any improvements. In the old accoutrements the seaman's belts crossed the chest, and in many cases this was found very inconvenient on the march, especially in hot weather, and men have sometimes taken them off and carried them over their shoulders. To remedy this there are now two parts to each set of accoutrements, one part for ship-board, consisting of the belt round the waist with the cutlass, and the other part is arranged in the shape of braces supporting the belt, so that they never cross the chest. I wish to know whether, if Captain Campbell had experience

[1] I look forward to the time when proper naval barracks will be established at the principal naval ports, one of which will be the headquarters of every Officer, where he will be required to requalify in all drills after every commission; and where young seamen, after serving their time in the training ships (harbour) and squadrons at sea, will be thoroughly disciplined and trained in the use of the rifle, field-gun, &c., and how to get them into action, before joining the "sea-going" ships for service.—W. F. M.

of these, they answered the purpose for which they were intended. Then Captain Campbell says, "The 9-pr. guns were drawn by eight oxen, and for each gun there were two carts drawn by six oxen each, and containing together 160 rounds of spare ammunition." Was that spare ammunition 160 rounds per gun, or for all the guns landed, and what was the actual number of guns? The paper says, "It is out of the question that guns can be dragged by men on a march." That is perfectly true. Everybody who has had anything to do with field-guns on shore must agree to that. Then, what were the vehicles alluded to—service vehicles or the ordinary vehicles of the country? I am sure we must all be very much obliged to Captain Campbell for bringing this subject before us. We all know in England at any rate the value of the Naval Brigades with which he was connected; and although I have heard an opinion expressed by Officers that there is no necessity for Naval Brigades, that they have no business to be landed at all, the fact is this, with our large Colonial Empire and enormous commerce all over the world, we must occasionally get into small wars, and the Navy being on the spot must be the first to commence operations. Then, of course, if the matter expands, they must be assisted, and when it comes to a large affair, the Army must take it up to settle it. I am sure we must all feel with Captain Campbell in his closing remarks, viz., "I cannot conclude without a word of sympathy and regret for my old comrade Commander Romilly and his gallant companions who fell in the Transvaal."

General Sir WILLIAM CODRINGTON: May I ask a question with regard to the ammunition which was carried—I think it was mentioned that 1,500 rounds were carried on pack-mules—was it in the square boxes usually used for infantry ammunition? And I should like further to ask whether they were carried sufficiently well so as to be got to the troops when they were wanted up steep places, as well as on the march?

Captain VERNEY: I wish to say a word about the sword-bayonet. Certainly in India our blue-jackets liked the sword-bayonet very much indeed, and were glad to leave the rifles behind, and to do a great deal of work with the cutlass. Their experience was that their power with the cutlass was at the point, and not as a cutting weapon. They found in India that the natives are accustomed to cutting with their swords. If you met them with the cutlass attempting to cut they would stand, but if you met them with the point they would turn and run. So that there is some advantage with the cutlass. A man can leave his rifle behind and go on with the cutlass. We found our band of the greatest possible use in India. When the men were tired they could always march two or three miles further with the band. The band had a wonderfully inspiriting effect on the men, and under all circumstances we found them of great advantage. But the bandsmen were told that they could only go up the country if they were drilled. At the capture of Lucknow, a military Officer came to say they had captured a gun, and wanted some of the Naval Brigade to work it. The First Lieutenant said to me, "You take the band and work it." We went down and worked this gun, the Sepoys' own gun, and blew open the gate they were defending: so that bandsmen may be of real use in action. Then we had some engineers with us, who were quite invaluable, and so were the stokers. They sighted the guns, made tangent sights for the guns, and acted as armourers, and we found them extremely valuable for all sorts of fine work that I do not think blacksmiths could have done. The carpenters also were invaluable. They picked up all sorts of trades. They became wheelwrights, and repaired tent-poles. Of course they were drilled the same as other men. Then with regard to the drill, I do not know that one ought to lay too much stress upon the importance of drilling men before they go on shore. No doubt a certain amount of drill is necessary, but our men used to drill every day when not on the line of march. We had 40 men to a gun—they were 68-cwt. guns—and these men were drilled to run these guns about as hard as they could lay their legs to the ground: and at the action of Cawnpore a sight was seen that was never seen before. The 68-pr. was in the front with the first line of skirmishers. It was remarked in the despatches that that sort of thing had never been known before. Of course that sort of drill could not be taught on board ship, but it was suited to the exigencies of the time. From the experience I have had in the Crimea, in India, and other places, Naval Brigades are always kindly welcomed by

the Army, and I should like to see an increase of Naval Brigades, and then we should not want so many soldiers.

Captain CAMPBELL: I have no particular objection that any company should be called a Naval Brigade, but in a large force if you permit this thing to be done you will find constant confusion; you will find Officers commanding a Brigade of so and so, and the Officers of the Army will not know who is the chief. It was found very necessary to adopt that rule. I cannot give an opinion about the method of crossing the river which Captain Verney referred to. I have never seen the plan adopted. I know it would have been quite impossible where we crossed the Tugela, for one simple reason, that the river was 200 yards broad and extremely shallow in the centre. If you had attempted to cross the river with a long hawser, and the pontoon to swing backwards and forwards at an angle to the tide, the bight of the hawser would catch the bank in the middle, and would not travel. I can understand the system being successful in a deep and narrow stream, but in that particular case it was not possible to adopt that plan. I entirely concur with the remarks of the Officer who spoke as to the training. I decline to state further whether the men who served with me were sufficiently trained or not, but there can be no doubt that the training of the Officers is very much behindhand for the purposes of landing. I should like to see the Officer on board ship detailed with the company of men with which he is to land. In the same way as the men are stationed to a gun, so the Officers should be stationed to a company. They should always be required to drill it. Take the drill out of the hands of the instructors, and insist on the Officers drilling them, and in fact let the men and Officers become acquainted with each other. Unless this is the case, you can never land in a hurry with any degree of confidence in the men and Officers. Supposing you want to throw your men on shore, unless the Officers have been in the habit of working with those men and taking command of them, you will not succeed, in my opinion. I was asked to describe the material for the leggings. We used thick canvas coated with paint, but I should think any other material would do equally well. A sailor wears heavy trousers and no braces, and it is imperative you should keep the weight off the shoulders. They were made on board by the men. The signalmen were landed with the other men, and they were extremely useful. The same signals were used as at sea. I still stick to my own opinion as to the sword-bayonet, notwithstanding the unfavourable criticisms it has received. I think for some purposes the lighter bayonet would be preferable.

The CHAIRMAN: Would you recommend the sword-bayonet?

Captain CAMPBELL: Those were the things we used for cutting down brushwood and grass, but I would hardly encumber a man with those things for that little use. Then something was said about the men leaving their rifles and taking the sword-bayonets to fight with. That is a thing I should never consent to. The man and the rifle ought never to be parted, in my opinion. The new accoutrements were not issued to the men in my ship. I have seen them, and I think them a vast improvement. Instead of cross-belts we adopted the plan of having the belt suspended from the shoulder. The amount of ammunition carried per gun was what I stated in the paper. It was per gun and not the whole amount. The wagons and vehicles used were those hired in the country. The ammunition carried on mules was carried in canvas bags made by the sailors. I really cannot exactly remember how it was carried at this moment, but the mules travelled about with the company always with about 1,500 rounds. I think they were carried in bags, but I cannot remember quite. They would travel anywhere and do anything. The band would be very necessary, and if the engineers and carpenters were all armed with rifles, I should have no objection to have them, but any man is an encumbrance who is not armed with a rifle. As to extra Officers, they require extra servants, extra attendants, and unless they are fighting Officers they had better be left behind too, I think. I cannot speak about the 40 men who were accustomed to drill in the Indian Brigade. I always found that every man that could possibly be spared was wanted for other purposes. There were no men to be spared to drill or anything else. Perhaps in another war they will have less work to do.

The CHAIRMAN: I am sure you will all pass a vote of thanks to Captain Campbell for the interesting paper he has given us.

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Horton, S. G., Lieut. R.A.
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Roberts, C. F., Col. N.S.W. Artillery.
Neville, George, Lieut. R.N.
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Gildea, James, Major 4th Batt. Royal Warwickshire Regiment.
Wickham, H., Lieut. Scots Guards.
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Aldrich, Pelham, Commander R.N.
Vane, F. P. F., Lieut. Scots Guards.
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Hay, Hon. A., Lieut. Scots Gds.
Morgan, H. J., Lieut. R.N.
Macpherson, Sir H. T., V.C., K.C.B., K.C.S.I., Major-General.
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Finnie, R. B., Lieut. Scots Gds.
Rouse-Boughton-Knight, C. A., Lieut. Scots Gds.
Wigram, H. H., Lieut. Scots Gds.
Drummond, L. G., Lieut. Scots Gds.

ERRATUM.

No. CXVII, page 600, line 3, for ship-keeping read *log-keeping*.

OCCASIONAL PAPERS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

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THE INTENDANCE, TRANSPORT, AND SUPPLY SERVICES IN CONTINENTAL ARMIES.

By Brevet Lieutenant-Colonel HILDYARD, Highland Light Infantry.

THE importance in military operations of good systems of transport and supply, together with the able direction of these services, has increased with the growth of armies. It is indeed, at the present day, a recognized fact that, to a great degree at least, the success or failure of military enterprises, and more especially of those on a large scale, must depend upon such an organization of the administrative departments as will ensure the adequate supply and punctual distribution of provisions to the troops in the field. This has been brought prominently to our notice by many past campaigns in which our troops have been engaged, and more especially by the late expedition to Egypt. The exceptional circumstances under which this expedition was undertaken, the nature of the country, and the necessity for prompt action all tended to increase the difficulty of getting sufficient provisions to the front for the troops first pushed forward. It would, however, be foreign to the purposes of this paper to enter into this, or to discuss the organization of the systems actually in force in the British Army, detailed information regarding which is to be found in Lieutenant-Colonel Furse's admirable treatise on Military Transport.[1]

The importance of the subject has been fully recognized abroad, and the reorganization of the combatant arms which took place in each of the great armies of the Continent after the commencement of the new military era, dating from Sadowa, has been followed at lesser or greater intervals by a thorough remoulding of the departments upon which the services of supply depend for their execution.

These are the Intendance, the Transport, and the Supply Service proper. The first of these embraces generally what are termed the administrative services, the scope of its authority and responsibility, as well as the measure of its independence, differing in degree in the several armies of the Continent, but embracing in all of them the branch known in our own and some others

[1] "Military Transport." By Lieut.-Colonel G. A. Furse, D.A.Q.M.G. London, 1882, noticed in No. CXVI of the Journal.

as the Commissariat. The Transport service is taken to include all the means which would be available for the conveyance of provisions and stores, whether with the first line of an army operating in the field or on the lines of communication with its base. These comprise, besides the regularly organized carriage or pack train attached more immediately to the troops, such improvised trains for the creation of which regular provision is made beforehand. In some armies these services, or the first of them at least, are provided for by a special corps, capable of expansion on mobilization, and subdivided in such a manner as to allow of adequate portions being detached for the manifold services required, while in others the several arms, or some of them, are provided with a due proportion of material and horses, the Officers and men for the working of which are provided by the corps concerned. The term "Transport Service," therefore, as used in the present paper, does not necessarily signify a special corps, though in some cases it may do so, but rather the system, whatever it may be, under which the wheeled or pack transport forming the train of an army is organized. There is generally so close a connection between the transport allotted to the several services of supply, ordnance and engineer stores, the medical or sanitary department, &c., that it would only lead to unnecessary confusion were an attempt to be made to dissociate absolutely from the others, for the special purposes of this paper, that portion more immediately connected with supply. As, however, this is the subject more particularly under consideration, while adverting only briefly to other branches where it appears necessary to do so, more detailed examination will be reserved for the service of transport as affecting supply alone.

The third and last head under which the general subject will be considered is that of Supply, which will be taken to embrace everything connected with the actual collection, storing, forwarding, and distribution of provisions, under the officials to whom these services are entrusted, and who are, as a general rule, a separate commissariat branch acting under the orders, supervision, and control of the Intendance.

Speaking generally, it may be said that the majority of the Continental Powers have based the reorganization of their departments, as of their armies, upon the German system, the completeness of which has been proved to demonstration by two successive campaigns, and has since been further improved by modifications introduced into them in 1872. This being the case, it would appear preferable to commence this paper with the systems at present in vogue in Germany, which will be treated in considerable detail. For the sake of clearness and conciseness, each branch of the subject will be examined under a separate head, but as these several branches have in many respects the closest connection one with the other, a hard-and-fast line cannot always be drawn between them.

Germany.

Intendance.—In Prussia the 2nd division of the Military Economy Department, which is under the War Ministry at Berlin, deals with the services of supply, forage, clothing, equipment, and transport, which, with the exception of the latter, are directly under the Intendance. A similar arrangement exists in the States of Saxony, Wurtemberg, and Bavaria. The Intendance, therefore, operates under this department, to which it is responsible in all administrative matters. In peace-time it is a purely civil and non-combatant branch, charged with the economic management and control of the departments, but without any military command or special corps of troops under it. Its officials have, however, the status of Officers, though without defined military rank, being classed as superior military officials.

The several services which fall under the control of the Intendance were reorganized in 1875, being classified under five heads or sections. Of

these, the first embraces finance, administration of non-regimental officers and non-divisional troops—such as the artillery, train, rifles, engineers, &c.—schools, establishments, marches, transport, military law, &c. The second deals with the supply of provisions and forage, the verification of accounts, and the control of garrison military chests. The third has charge of the central clothing magazines, the clothing of non-divisional troops, the train material, and the accounts of artillery establishments. The fourth has barracks and barrack furniture, fuel, and lighting arrangements, and regulates lodging allowances. The fifth section deals with the administration of sanitary establishments, pensions, and invalids.

When on a peace footing an Intendant is solely and personally responsible for all the administrative services within the army corps district; but he has under him Intendants in charge of each of the five sections, besides one for each division of infantry and cavalry, to whom he delegates a certain portion of his authority. Thus the chief of the second section has very considerable independence in commissariat matters.

The only approach to a regular commissariat department in peace-time is to be found in the *personnel* of the supply service, whose duties are restricted to the charge and administration of the permanent magazines for the storage and issue of bread, forage, &c., and who have no military status whatever. For the whole German Army these officials in their several grades number only 326, with about an equal number of subordinates. The superior officials of the supply service are drawn from non-commissioned officers who have completed twelve years' service, and are in possession of the special certificate entitling them to civil employment. In exceptional cases civilians are also admitted. As may be supposed from the small establishment maintained, magazines exist only in certain of the numerous garrisons, the troops quartered in the others being supplied altogether by contract. The subordinate officials are chosen exclusively from amongst old soldiers who have served their time and become entitled to pension, irrespective of rank. Workmen, labourers, &c., are engaged as required from time to time, the preference being given to old soldiers. Uniform, which is the same for all the departments, is worn only on special occasions, and not in the ordinary execution of duty.

Special arrangements are made in order to provide for the efficient formation of bakery columns on mobilization. In the first place, a small permanent cadre is maintained in each train battalion, composed of men by profession bakers who have served at least a year in the ranks. To allow of expansion, every year twenty-five men are detached from each infantry division for training, who are called up from the reserve on mobilization to complete the columns.

On the army taking the field the higher officials of the Intendance are distributed in the following manner: An Intendant-General is appointed, who is attached to the Staff of the Inspector-General of Communications, and has the general superintendence and control of the whole of the administrative services of the entire force in the field, but without interfering with the field Intendants attached to the several bodies of troops, that is to say, the army corps, étappen, and divisional Intendants. In the 1870–71 campaign, the Intendant-General was a General Officer who had, in 1866, been Quartermaster-General of an army. He was almost daily at the councils of the General Staff. To each separate army, if more than one, an Army Intendant is appointed, having similar functions with the armies to which they are severally attached. Étappen Intendants are also nominated as required to the several étappen districts on the lines of communication. Provisional Intendants take over from the first day of mobilization the peace army corps districts, the regular army corps Intendant assuming the entire supply of the mobilized corps, for which he is responsible to the General commanding. Under him the executive arrangements are carried out by the

Intendant in charge of the second section field commissariat department, to which thirty-six officials are allotted, besides those with the field bakery. Under them again the divisional Intendants carry out the administrative services in their own divisions.

To provide for the excess of officials required to form the necessary staffs on mobilization, lists are prepared by the Intendance in time of peace. They are divided into two classes, one of which is composed of officials of higher grade to whom is given the rank of Officer, and who are taken from amongst Officers of the active army having completed six years' service, and from civilians qualified by having passed through a university, or who have been trained in the lower branches of the civil service, and are Officers of the Landwehr or Reserve. The second class is composed of subordinate officials ranking as non-commissioned officers, who perform the duties of secretaries, clerks, &c., and are recruited almost exclusively from non-commissioned officers who have completed twelve years' service.

The chief Intendance official at the headquarters of a corps d'armée or division represents the War Ministry in all administrative matters. He is the adviser of the General Officer commanding upon all questions referred to him by the Chief of the Staff, but he reports direct to the War Ministry, acquainting the General Officer with the nature of his communications. He is, nevertheless, strictly subordinate to the General Officer commanding, as also to the Chief of the Staff as his representative, through whom he receives his orders. The military staff issues all orders on administrative matters, for the execution of which the Intendance is directly responsible. The Transport service is a special branch, having a strictly military organization, with the command of which the Intendance has nothing to do, but it has the disposal of it for the execution of the several administrative services.

The Intendance has in the field all the arrangements for the procuring, storing, and distribution of provisions and forage, the charge of field bakeries, the arrangements for the execution of requisitions, the formation of transport trains, the establishment of provision depôts and magazines, besides other services unconnected with supply.

Transport.—In the German Army the general term "Train," as applied to the *personnel*, includes all those who in action do not serve to augment the number of combatants; but it is used in a more restricted sense to denote the regular formations, maintained for the purpose of providing for the transport services of the Army. These are organized by battalions allotted to the several army corps, the respective numbers of which they bear. Of these train battalions there are in Prussia 14, besides 1 company for the Hessian division, those attached to the Guard and two other army corps being composed each of 3 and the rest of 2 companies, or 31 companies in all. In Saxony, Wurtemberg, and Bavaria there is in each case 1 battalion of 2 companies, formed in the same manner, making with the Prussian battalions a total of 17 battalions, comprising 37 companies. The battalions are officered by the transfer of Officers from the cavalry and artillery, no promotions from the ranks being permitted in time of peace. The cadres are completed on mobilization from cavalry Officers of the reserve, if necessary. Each battalion is commanded by a field Officer, the whole being under an Inspector of the Train, who is a General Officer, or Colonel acting as Brigadier, and has the entire superintendence of the train depôts and *matériel*. To each battalion is appointed a staff of 2 Officers with clerk, surgeon, paymaster, and other officials attached.

The strength of each company on a peace footing is 4 Officers, 22 non-commissioned officers, 15 acting ditto, a bugler, 24 men serving for a continuous term of three years and 39 for six months only. The depôt has 2 Officers and a saddler, in whose immediate charge is the whole of the *matériel*, equipment, &c., required for the formation of the several transport

columns on mobilization. There is also a division of artificers of various trades, 10 in number, for the execution of repairs, and a bakery section of 9 men. On mobilization a battalion on a war footing comprises a *personnel* of 34 Officers, 186 non-commissioned officers, 187 artificers, and 1,729 train soldiers, besides Officers and men of the medical, pay, and veterinary departments, in all 2,238, with 611 wagons, and 2,216 horses.

The train battalion[1] and its companies, thus expanded on mobilization, are thenceforth dissolved, so far as their individuality is concerned, and they are merged into the several transport columns and other formations required for

Table I.

Establishments of Train and Columns formed from it in the German Army.

Formation.	Peace.				War.			
	Officers.	Personnel.	Horses.	Wagons.	Officers.	Personnel.	Horses.	Wagons.
Battalion Staff	2	4	3	25	2	18	16	1
Company	4	113	63	12				
Bakery Division	..	9						
Train Depôt	2	1	1	598				
Battalion	10	233	130	647	34	2,102	2,216	611
Provision Column	..	..	..	..	2	122	166	32
Sanitary Detachment...	..	..	..	..	3	247	45	12
Horse Depôt	..	..	..	..	2	112	200	2
Field Bakery Column ..	..	..	..	..	1	112	15	2
Park Carriage Column .	..	..	..	..	2	139	204	82
Squadron of Train Escort	..	..	..	..	4	132	204	2
Total of Train Battalions.....	213	4,837	2,457	..	785	38,451	46,017	12,584

Note.—5 Provision Columns..... } Per Train Battalion and Army Corps.
3 Sanitary Detachments..... }
1 Horse Depôt..... }
1 Field Bakery..... }
6 Park Carriage Columns.... }
1 Squadron Train Escort.... }

the army corps, each battalion forming in addition a depôt division of two companies. The formations thus created are six in number, comprised under the following heads: 1st, the Staff, which is simply transferred intact to the Staff of the army corps commander; 2nd, 5 Provision Columns, each of which is composed of 30 four-horsed provision wagons, 1 reserve wagon, and a forge; 3rd, 3 Sanitary Detachments, with bearer company, being one for each infantry division, and one for the corps artillery, each of which is commanded by a captain of the train battalion; 4th, a Field Bakery Column, of 2 four-horsed oven wagons, two for bakery and butchery *matériel*, and one other; 5th, a Horse Depôt train of 2 two-horsed squadron baggage wagons, with forge;

[1] For peace and war establishments of Train Establishments and Columns, see Table I.

6th, 6 Park Carriage Columns, each composed of 80 two-horsed wagons to carry 19½ cwt., 2 baggage wagons, with forge, and 1 escort squadron. These columns were horsed by hired or requisitioned teams in the campaigns of 1870–71, but owing to inconvenience and delay found to arise from this course, it is intended in future to provide beforehand for their supply. In the same manner, the wagons which have hitherto been requisitioned or purchased when required, are now secured by contracts carefully examined and revised annually during peace-time. The army corps bridge train is also attached to the battalion. Besides all these formations,[1] a number of wagons are requisitioned from municipalities, when in an enemy's country, for the purpose of conveying provisions and forage for the troops during their marches, but they do not form any part of the regular train.

Table II.

List of horses and wagons of a mobilized Corps d'Armée, including the guns and other artillery wagons not horsed by train, so as to show the total wheeled Transport of all kinds.

		Carriages.	Horses.
1	Staff of Corps d'Armée	5	14
	Services relating to Staff of Corps d'Armée	14	36
2	Staff of Division	1	4
	Services relating to Staff of Division	8	16
3	Staff of Infantry Brigade	1	2
4	Staff of Cavalry Brigade	1	2
5	Staff of Artillery Command	1	2
	Services relating to Staff of Artillery Command	7	14
6	Staff of Infantry Regiment	1	2
7	Each Regiment of 3 Battalions	28	74
8	„ Battalion Chasseurs	12	24
9	„ Regiment of Cavalry	8	18
10	Regiment of Artillery { Corps	172	992
	{ Divisional	151	878
11	The 10 Ammunition Columns (4 Infantry, 6 Artillery)	256	1,444
12	3 Companies Pioneers	12	36
13	3 Bridge Equipages	61	334
14	2 Columns of Pioneers' Tools	12	48
15	Staff of Train Battalion	5	10
16	5 Provision Columns	160	650
17	6 Movable Park Columns	492	984
18	3 Sanitary Sections	39	72
19	Field Bakery	2—3	8—12
20	Horse Depôt	2	4
21	12 Field Hospitals of Corps	72	216
	Total Train of Corps d'Armée of 3 Arms	1,760	6,500

The train battalions of the Saxon, Wurtemberg, and Bavarian troops are assimilated to the Prussian system, and the Hessian division has a separate company, from which are formed 3 provision columns, 2 park carriage columns, 1 sanitary detachment, and a horse depôt.

As will have been seen by Table I annexed, the total of the train establish-

[1] For horses and wagons required, see Table II.

ments of the German Army on a war footing amounts to 627 Officers, 39,671 of other ranks, 11,273 wagons, and 40,948 horses, these numbers being exclusive of Officers, veterinary surgeons, and paymasters. In them are included two train soldiers attached to each company, one for the purpose of looking after the company cart, the other in the capacity of groom to the commander of it; but others, to the number of 130 per army corps, attached as grooms to the army corps, divisional and brigade staffs, are borne separately to the establishment of the train battalions. To ensure the prompt provision on mobilization of the large number of men required to complete the war establishments, it is indispensable that all the necessary arrangements should be worked out in minute detail in time of peace, a task which is executed under the direct superintendence of the train battalion commander. As has already been indicated, the permanent establishment of the several companies is composed, partly of men serving continuously for three years, and partly of men spending a term of six months only in the ranks. The whole are recruited from the men liable to army service, who appear less fitted for the combatant arms, the preference being given to those who are accustomed to horses.

Of these the three years' men, termed the permanent portion, are given as complete an instruction in riding, drill, &c., as is given to cavalry soldiers, and they are further trained in driving, and undergo a special course of theoretical instruction. On mobilization these men supply non-commissioned officers to complete the increased establishment. The six months' men, forming what is called the "variable portion," are simply taught ordinary riding and driving, and are destined to form a reserve sufficiently numerous to complete the establishment of train soldiers. Should these not be sufficient in number, recourse is had to cavalry reserve men and train soldiers, belonging to the Landwehr.

The whole of the wagons, harness, *matériel*, and equipment of every description required to complete the several columns and formations are kept stored at the train depôt of the army corps, under the special charge of two Officers of the battalion, who are responsible for its being maintained complete and efficient in every particular. All the clothing, the equipment for the sanitary detachments, the accessories belonging to the bakery columns, in short every item of equipment and stores, is kept carefully classified and ready for immediate issue. To ensure this being the case, as well as to afford exercise in issuing and storing, loading and unloading, frequent practice is given by "mobilizing" single wagons here and there, when those selected are completed in every detail for the field. This is facilitated by a list or inventory being attached to each wagon, on which is recorded every article belonging to it, as well as the particular store and shelf even where it is to be found. With a view also to ensure proficiency in driving and manœuvring, each company is constantly practised during the summer in a series of movements and manœuvres over varied ground with the division of twelve wagons, which is in its permanent charge. Such of the stores as are of a perishable nature are used up periodically for the current services, but they are always carefully replaced by fresh articles in the proportion in which they are withdrawn. The horses required to complete the formations are obtained by purchase under arrangements previously made, or if necessary, by requisition on repayment.

Regimental transport is not maintained in time of peace, but the necessary wagons and equipment are kept stored at the regimental headquarters ready to be horsed. These wagons, in proportion as shown in Table II, are only intended for the carriage of the company baggage, battalion ammunition, equipment, and medicines, and none are supplied for the carriage of any portion of the provisions, but one marketing cart per company and squadron has generally been appropriated for this purpose.

The order of march of the regimental transport and train formations is

arranged in the following manner. The several columns are divided into divisional and army corps train, and these again into a 1st and 2nd line. To the 1st line of the divisional train belong led horses, medicine carts, regimental wagons of batteries and pioneer companies, with the exception of the baggage wagons and market carts, all of which remain with the troops; also the small-arm ammunition carts, which march generally in rear of the respective brigades to which their battalions belong. The 2nd line of divisional train is divided into two portions; one of these, composed of the staff, regimental baggage, and marketing carts, follows about a mile in rear of the troops, being under the charge of an Officer, who has at his disposal a small cavalry detachment.

The other portion, comprising the divisional provision columns and field hospitals, is about 4¼ miles behind the first portion, being also commanded by an Officer with a mounted detachment.

The army corps train is generally under the direct command and superintendence of the commander of the train battalion, being divided likewise into two separate portions. In the 1st line, which marches a full 4½ miles in rear of the hindmost troops, are included the wagons of the administrative departments, the second portion 2nd line of the divisional train, the army corps bridge-train, 4 field hospitals, 2 provision columns, 1 park carriage column with *matériel*, and the field bakery column or that part of it not attached to the infantry divisions. The 2nd line follows about three-quarters of a day's march behind the rearmost troops, and comprises the horse depôt, the remaining field hospitals, provision and park carriage columns. As a rule the ammunition division of the army corps, composed of 2 infantry and 3 artillery ammunition columns, precedes the 1st line of the army corps train by about half a day's march.

Supply.—In Germany the methods of supply during the periods of peace and war respectively are quite distinct, the issue of rations in the former case being only exceptional. In peace-time the rationing of the troops is provided for by the issue of a bread ration and the provision of one meal, for which a certain stoppage is made, besides a breakfast of soup or coffee. The stoppage is fixed, but the cost for the meal, or "ordinaire" as it is called, is regulated quarterly in each garrison. In exceptional cases, where the day's ration is provided in kind, it is regulated as follows:—Bread, 1 lb. 10·35 ozs.; meat (raw), 5·2905 ozs.; rice, 3·1743 ozs.; or barley-meal, 4·2324 ozs.; or beans, peas, &c., 8·1115 ozs.; or potatoes, 3 lbs. 4·705 ozs.; coffee, ·468 oz.; and salt, ·87 oz.

During the manœuvres this ration is increased in meat and vegetables, the former being then 8·8175 ozs. When occupying cantonments rations are not issued, but the soldier is fed by the household on which he is billeted, repayment being made by the State. In the field all the men with the mobilized armies are provided with a free ration, which is again considerably increased, and consists of the following amounts:—Biscuit, 1 lb. 1·63 oz.; or bread, 1 lb. 10·45 ozs.; salt pork, 5·98 ozs.; or fresh meat, 13·206 ozs.; or preserved meat, 7·054 ozs.; rice, 4·408 ozs.; or peas, beans, &c., 8·81 ozs.; or potatoes, 3 lbs. 4·5 ozs.; salt and coffee, ·881 oz. each.

Thus the minimum weight of a day's ration, excluding fresh meat and bread, neither of which is carried by the supply columns, is:—With salt pork and rice, 1 lb. 13·79 ozs.; with preserved meat and peas, &c., 2 lbs. 3·27 ozs. The above is, however, subject to alteration according to circumstances, and an addition is frequently made to it when the troops are compelled to undergo exceptional hardships, on which occasions a spirit ration is generally issued. Luxuries, such as beer, wine, butter, and tobacco, are also added when procurable in an enemy's country without difficulty by means of requisition.

The method of actual supply and issue must necessarily vary in all armies according to circumstances, but the Germans by providing in detail before-

hand for the several phases which must always succeed one another in a campaign have done their utmost to simplify this most difficult and important service. The several periods laid down in their regulations comprise :—1st, that occupied by the actual mobilization ; 2nd, the time during which the troops are being conveyed, whether by rail or road, to their respective points of concentration ; 3rd, the period during which they remain stationary in the district in which the concentration is effected, previous to taking the field ; 4th, the time occupied by the course of active operations subsequently undertaken.

During the period embraced by the mobilization the troops are supplied generally as in time of peace, but where it becomes necessary to billet troops in villages at a distance of more than about 12 miles, as also when large masses of troops arrive in succession, magazines are established for the purpose of facilitating supply. While the mobilization is in progress also, the wagons of the provision and park carriage columns are completed with stores, and such articles of food as do not quickly deteriorate are supplied to the field hospitals and sanitary detachments. The so-called "iron ration" (a three days' reserve of bacon or preserved provisions, rice, biscuit, coffee and salt) carried by each man has also to be procured and issued, as also one day's corn for each cavalry and saddle horse and three days' for artillery and train horses, the latter being carried partly on the horses and partly on the wagons. In addition to these, one day's ration, both for man and horse, of the same nature as the iron ration, is provided for the troops travelling by rail and loaded on the regimental wagons, to provide the first day's subsistence after leaving the railway on reaching the point of concentration. The first consignment to the provision columns is generally two days' biscuit and four of preserved meat and vegetables, coffee, and salt. The park carriage columns are generally loaded, part with flour and meat rations, part with forage.

The provisioning of the troops during their transit by rail to the points of concentration is provided for at certain fixed halting-places, where hot meals, including coffee, are furnished, the necessary arrangements, including the establishment of canteens and the provision of drinking water, both for men and horses, being made in conjunction with the Intendance authorities of the district. At the point of embarkation an allowance of bread and forage is issued for the entire railway journey. The troops marching by road are billeted and subsisted by the inhabitants whenever this is possible, temporary magazines for the issue of provisions being established at suitable points when this cannot be done.

During the period of concentration, immediately preceding the commencement of hostilities, the forces collected are too numerous to live entirely on the country, which necessitates the establishment of magazines. With a view to facilitating this, the despatch of the force by rail comprises a certain number of trains laden with supplies alone, chiefly of flour, meal, and oats, the field bakery columns being also sent forward as early as possible, for the purpose of converting the former into bread. The étappen intendants are responsible for the supply of the troops after debarkation until they reach their final cantonments.

The regulated system adopted by the German armies for the supply of the troops during active operations in the field combines the carrying by each man and horse of the reserve rations previously referred to ; the transport with each body of troops of a sufficient supply of provisions to render it independent for some days of other sources ; the establishment of magazines, permanent or otherwise, and the extensive utilization of the resources of the country in which operations are conducted for completing these supply columns and magazines, and also in special cases for the direct supply of the troops. The reserve or iron rations—under which appellation they are generally known—consist of three days' rations per man carried in the pack, the con-

sumption of which is most strictly forbidden unless under special orders, which are directed only to be given in cases of great emergency. To ensure strict compliance with this order, a minute and frequent inspection of the rations has been found necessary and is regularly carried out, the men being otherwise apt either to consume or to make away with them, in order to lighten in some degree the weight they have to carry. Notwithstanding, however, every precaution to the contrary, it repeatedly happens that these rations are made away with, and it has been frequently urged that their utility is more apparent than real; for, whereas the men are permanently burdened with the carrying of them, it is only in the rarest instances that they are called into requisition. In such exceptional cases, however, it must be remembered that their value cannot be over-estimated. As a proof of this may be cited what happened after the continuous fighting round Metz between the 16th and 18th August, 1870, when the provision columns of the German Army Corps were unable to come up, and but for the reserve rations carried by the troops they must have been left without food for the greater part of three days. As with the men, so also for the horses; the reserve corn ration renders the movements of cavalry more independent, particularly in a country where forage is not abundant.

The bulk of the provisions and forage carried with each army corps is conveyed in the provision and park carriage columns respectively. As has been already noted under the heading of transport, there are 5 provision columns, each composed of 30 wagons carrying an ordinary load of $13\frac{3}{4}$ cwt. each. Of these 2 are ordinarily attached to each infantry division, a proportion of the remaining one being assigned to the cavalry division, and reserve artillery.

Fresh meat, which is provided for by means of trains of live cattle, and bread, is excluded from their load, which is restricted to salt pork, bacon, preserved meat and vegetables, rice, coffee, and salt. The minimum weight of a ration is, when salt pork and rice are provided, viz., about 1 lb. 13·79 ozs., and with preserved meat and peas it is 2 lbs. 3·27 ozs. Taking the mean of these, and allowing for packing material, the weight is 2 lbs. 9·44 ozs. Thus each provision column will convey 22,000 rations, or about two-thirds of a day's requirements for an army corps of 40,000 men. As this strength is seldom maintained in the field, the 5 provision columns may be said roughly to carry rations for the army corps for four days.

There are two methods of packing, each of which has certain advantages. By one of these the wagons are loaded with one description of articles only, which allows about 23,000 complete rations to be carried, leaving a considerable excess of coffee and salt, which is very desirable. By the alternative method, each wagon is laden with the several articles included in the soldier's ration. Of these each wagon can carry about 750, or in all 22,500, with a large surplus in this case also of coffee and salt. This method necessitates a slight increase in weight, but, on the other hand, it simplifies the task of issuing enormously. It is usual, therefore, to adopt a combination of both plans in storing the columns, two or more of which, loaded with complete rations, are kept nearest to the troops during the course of operations, so that no difficulty or delay may occur on distribution.

The wagons of the park carriage columns carry a heavier load that those of the provision columns, taking 800 complete rations, or 50 more than the latter, but they are only two-horsed, and cannot consequently be expected always to follow the troops in the same manner. They are more generally employed in carrying forage, of which there are two rations, the heavy weighing 12 lbs. 6 ozs. and the light 11 lbs., and as the number of horses on the latter is comparatively small, being limited to those of mounted infantry, rifle, pioneer, and train officers and officials, the mean may be taken at about 12 lbs. 2 ozs. At this estimate the park carriage wagon will carry 177 rations, and the 5 columns of the army corps, each of 80 wagons, 71,000, or about 7 days' for the

horses with it. It is usual, however, for a portion at least of these to be used for carrying provisions, so that between them and the provision columns, there are conveyed 7 days' meal and biscuit, 3 or 4 days' preserved meat and bacon, 7 days' of the several other articles of messing, and 7 or 8 days' forage. They are also accompanied by live cattle columns adequate for 6 days' supply of fresh meat. The sixth park carriage column of each army corps is detached from it as soon as formed, for service on the lines of communications, a provision made only since the last war, on account of the difficulty experienced in organizing efficient transport columns with promptitude, for the execution of services on the lines of communication.

The supplies conveyed by the regular columns are considered, in great part at least, as a reserve also, for theoretically they are only intended to be drawn upon when other sources of supply fail. In this case, however, which is after all in practice the normal one, as the columns are emptied, they are despatched without delay to the nearest magazine or other source of supply, for the purpose of being reloaded, with orders to rejoin as quickly as possible the troops to which they are attached, which is done when necessary by forced marches.

To ensure supplies and stores being regularly received from the rear to replenish the columns and provide for the sustenance of the troops when stationary for any time, whether during concentration or in the course of operations, a regular system of magazines is prescribed, which are classified under the heads of reserve, main, advanced, and étappen magazines. With this view, on the commencement of a campaign, the formation of a base for subsistence is ordered for each army, in rear of the district in which its concentration is effected. Well in rear of this again, the reserve magazines are established, their selection depending upon local and other circumstances. The space required for the large accumulation of provisions and stores required to be made is only to be found in large towns and good roads, with railway communication to the front is indispensable. They are formed more particularly with a view to the possible contingency of a retrograde movement becoming necessary, and are consequently stationary as a rule, but in the case of the main magazines in the front being advanced, they are moved up to take their place.

These main magazines are established on the base, being provisioned as far as possible beforehand, and completed by means of contract. They are taken charge of by the Army Intendance, which equips from them the several provision columns for the army and étappen services, assembled for the purpose in their vicinity, and causes the 3 days' reserve rations to be distributed, if considered necessary, to the men. The number and dimensions of the main magazines depend in great part upon the extent of the base. They are generally placed in fortresses for security, and the same qualifications are required regarding communications as for the reserve magazines.

It is only in case of absolute necessity that they are empowered to fall back upon the latter for assistance in replenishing their establishment of supplies, which is arranged for locally by contract or requisition, according to circumstances.

As the army moves forward, such points are chosen on the line of advance as lend themselves to the purpose, by reason of direct communication, railway being preferred, and here advanced magazines are established, and filled either from the country or from the main magazines in rear. As the army continues to advance these latter are moved further to the front in closer proximity to the 1st line, and placed in positions, about a day's march in rear of the troops, from which roads diverge in such a manner as to facilitate the distribution of provisions to the several army corps, which is effected either by means of the several provision columns or by direct daily issue to the troops.

To facilitate this a supplementary train of wagons is employed which acts

as an intermediary between the magazines and the troops. In cases where the latter are stationary and magazines have been established in their vicinity, the services of these are limited to drawing and distributing the provisions, but on the occasion of marches, at the conclusion of which no issue from magazines can be looked for, these wagons carry with the troops the provisions and forage for the day following, which are issued on the completion of the day's march. On these occasions they are reloaded with provisions obtained by the Intendance officials accompanying the troops, by means either of purchase or requisition. The wagons for this service are obtained from the local municipalities, and are attached to the several regimental units in proportion as required.

As the advanced magazines already established are superseded by others further to the front, they are converted in some instances into main magazines, where from their general situation and circumstances it appears expedient to move these further forward. In other cases they are formed into étappen magazines for the service of the lines of communication, or, if not suitable for this purpose, they are evacuated altogether. Such of them as are converted into étappen magazines pass under the administration of the Intendance authorities on the lines of communication, who accumulate in them provisions and stores from the resources of the country, supplemented so far as is necessary from the rear, ready to be pushed further forward as occasion may require.

In the German armies the principle which underlies the whole system of supply is that everything required shall, as far as possible, be obtained from the country in which operations are conducted. It is prescribed, therefore, that, whenever it is possible, the plan should be adopted of quartering troops when halted on the neighbouring villages, the inhabitants of which have to furnish the necessary subsistence. This is no doubt the simplest of all plans, but it is not practicable as a rule on account of the scarcity of provisions, and it cannot be depended upon alone excepting where small bodies of men, such as advanced guards, are concerned. For these it is the rule, and as in every town and village food is ordinarily available for the sustenance of its inhabitants for some days, troops in equal number can count upon obtaining provisions for one day at least. This is more particularly the case in the country, where provisions are always stored in greater proportion to the number of inhabitants than in the towns.

The supply, therefore, of the bulk of the troops has to be provided for by other means, and the system of requisitions is that ordinarily employed, and like every service connected with the German Army, they are conducted upon carefully worked out rules and regulations. The capabilities for supply of all the countries in which operations are at all likely to take place are ascertained beforehand in detail, and tabulated with a view to serving in war-time as data upon which to regulate the requisitions to be levied. By this means it is possible to allot with precision to the several units of the operating armies the areas to be embraced by them in their requisitions, which are distinctly defined in the orders issued by the General commanding from time to time. The apportioning of these districts is the business of the higher Intendance officials, acting in conjunction with the Commander-in-Chief and the commanders of armies, the work of arranging for and executing the requisitions required within the limits so laid down being carried out by the field Intendants of army corps.

It has been calculated by Von Schellendorf, upon the experiences of the 1870–71 campaign, that an army corps of about 35,000 men with 10,000 horses, advancing with a depth of about 9½ miles and a front of 5, should be able to subsist for one or two days upon the resources of an ordinary country, and that in most cases a second *échelon* can do so also, following the first at a moderate interval. From this it is inferred that, in a country of average

population and fertility, an army of from 100,000 to 120,000 men can advance without magazines or any special arrangements for supply, providing it does not halt for longer than one day at a time. This calculation can, however, only be taken to apply under very favourable circumstances, both as regards the nature of the country and the course of operations, any check to which would throw the whole force on its own resources.

During the campaign in Bohemia in 1866, and the early stages of the last Franco-German War, the system prevailed of payment for forced requisitions by drafts on the Government. This, however, was found to be disadvantageous in more than one way, and later on it was replaced by the introduction of cash payments, the money for the purpose being itself obtained by requisition. The result of this was that, whereas the inhabitants had previously driven off their cattle and secreted their supplies, they then flocked to the markets, which were opened, and at which they were certain to receive a good price for the produce they brought with them, no further difficulty being experienced in obtaining what was required.

The mode of collecting the supplies for distribution was, during the advance of the German armies upon Paris in 1870, arranged for in the following manner: The advanced guards were subsisted either by billeting or by means of direct requisition. These were on all occasions accompanied by an Intendance official, who entered into communication with the civil authorities, to whom he delivered the particulars of the requisitions required by the main body. In these were specified the exact nature and quantity of the supplies required, together with the place and time for their delivery, the municipal authorities being responsible for their collection and transport to the given spot by the time named. The first collection, made in the day intervening between the arrival of the advanced guard and the main body, was seldom found to be sufficient for the supply of the whole force, which was therefore generally subsisted from the provision columns on the day of arrival. These were filled again from the supplies collected in the meantime. Thus during the march from Metz to Fontainebleau and Orleans, a distance of 230 miles, which occupied twenty-one days, during which the troops were supplied entirely by requisition, the whole of the supply columns were emptied and refilled three times.

So soon as any considerable pause in the operations took place, as was the case during the investments of Metz and of Paris, the supply by requisition was rapidly exhausted by reason of the large masses of men collected. It then became necessary to resort again to the establishment of extensive magazines, which were in the first place stocked by requisitions levied upon the outlying districts, and by discharging into them the whole of the supplies carried by the provision columns. Subsequently they were replenished from the base by rail, and also from magazines on the lines of communication by means of the wagon columns. The importance of railways in facilitating the supply service on these occasions cannot be over-estimated, for it was found that a single train a-day sufficed to feed an army corps, while, during the siege of Paris, one line of railway fed the entire army of about 200,000 men for some time, besides bringing up siege *matériel* and a considerable number of reinforcements.

The provisions and stores thus drawn from the base of operations were for the most part obtained by contract, as were those required at other times when not obtainable by requisition. Thus during the first concentration of the German armies behind the Rhine prior to the commencement of hostilities in 1870, they were principally supplied by means of a fleet of steamers which brought down provisions purchased by contract in Belgium and Holland, while most of the supplies that had unavoidably to be obtained from the base, to complete magazines and forward to the front, were furnished

by contracts made with three large firms at Coblenz, Mayence, and Worms respectively.

Nowadays, indeed, with the extensive resources afforded by trade and private enterprise, little difficulty is experienced on the part of the Intendance in obtaining with punctuality everything they may require within the base of operations. It is the arrangements for conveying these to the operating troops in due quantity and proportion that constitute the principal difficulty. This is met in the German organization by a carefully worked out system for the constitution and working of the lines of communication, the officers administering which have, as one of their most important duties, to be constantly extending their movable magazines and keeping them stocked in such a manner as to be able to respond promptly to the requirements of the troops operating in the first line. This was regulated formerly on the principle of each army in the field maintaining its own communications with the base, and regulating its supply from it direct, as prescribed by the regulations of 1867. It was found, however, in the last war, that the enormous quantity of stores required for the large force in the field effectually blocked up the receiving stations in many cases, and produced a complete dead-lock at times, as when a change of front became necessary, while the general working of the lines of rail was greatly impeded, and much unnecessary delay and friction ensued. During the course of the war, therefore, it was deemed advisable to change this arrangement by placing the entire railway system under an executive committee formed at the headquarters of the Commander-in-Chief. Directly after the conclusion of peace new regulations were drawn up and embodied in an instruction issued in July, 1872, by which the lines of communication were ordered to be placed under the direction of a General Inspection of Communications and Railways, responsible for all the administrative services in rear of the first line, while delegating to representatives with armies and corps a large degree of independence in the execution of the general directions given.

Comments.—From what has gone before, it will be seen that the work of the Intendance is performed by officials holding no defined military rank, and is conducted both in peace and war on the principle of strict subordination to the military commanders, which is rendered more distinct by the appointment of a General Officer as Intendant-General, attached to the staff of the Commander-in-Chief. The Transport service, on the contrary, is organized on a strictly military basis, performing the carrying service for the Intendance under the arrangements and command of its own Officers. The organization of this service and the arrangements for mobilization are of such a nature as to facilitate the passage from a peace to a war footing and to provide for the rapid formation and completion of the several columns and establishments into which the battalions of the train are dissolved.

The most serious difficulties and delays were, however, experienced in the campaign of 1870 from an insufficient preparation in the matter of transport for service on the lines of communication. So far as the regularly organized columns were concerned, providing for the service of the troops in the field, things went smoothly enough, but the rapid advance and the interruption of railway traffic rendered it a matter of the greatest difficulty to get up supplies and form magazines for the replenishment of these columns. The 1st Army had luckily been able to get together 2,000 horsed wagons at Tréves before the commencement of hostilities, but the 2nd Army was quite unable to satisfy its requirements on mobilization, and was forced eventually to obtain 2,400 horsed wagons from the centre of Germany, which had to be forwarded to it, as far as possible by rail, adding immensely to the difficulties of working the lines, already sufficiently great. This necessity arose from the impossibility of obtaining the horses required, which is likely generally to be the case, the peasants either secreting their serviceable animals or sending them

out of the district. To obviate this difficulty in some degree, the creation of another park carriage column per army corps has been arranged for, in addition to the five which previously existed, for the purpose of being handed over to the étappen officials for service on the lines of communication.

As will have been observed, the methods of supply adopted by the German armies are most elastic and, while governed by certain fixed principles, admit of their adaptation according to the circumstances of the case. The regular supply of the soldier, under all but the most exceptional circumstances, is assured by the standing regulations regarding communications with the base, the establishment of a system of magazines between it and the front, the organization of the provision columns, and the carrying by the men themselves of reserve rations. A force separated temporarily from communication with its magazines has still a week's supplies with some days more of biscuit, coffee, &c., and it is able further to subsist for three days separated from its columns, which allows of a great liberty of movement. It is seldom, however, in Central Europe at least, that these supplies cannot be supplemented by means of requisition, and it is only in most exceptional cases, such as where large bodies of men are operating or where the troops are separated from their columns, as happened to the troops engaged before Metz, that any anxiety need be felt by a commander on the score of being left without provisions.

Whereas, however, the rules regarding the provision magazines, supply columns, and reserve rations are most strict, the prescription is equally so to live, as far as possible, upon the country. It is a standing order for Generals in command on no account to draw anything from the rear, so long as it is possible to obtain supplies either by purchase or by forced requisition from the district in which his force is carrying on its operations. This indeed is the leading principle of the German system, the application of which, more particularly where purchase is employed, enables the wheeled transport to be reduced to more manageable limits. The trains are still very extensive and unwieldy notwithstanding, occupying long intervals on the line of march and taking much time to come up when required, and any reduction of them would be so much gained in mobility. During the last war it was found that the system in vogue of supplying bread by means of the field bakeries which accompanied the troops was very defective, not half of these ever being in a position to be made use of, whilst the rest did not give altogether satisfactory results. The long trains of live cattle which accompanied the supply columns were also a source of constant delay, difficulty, and annoyance, whilst the depôts of them collected at many of the magazines were ravaged by cattle disease and large numbers had consequently to be slaughtered. But beyond this it was alleged that the conditions under which the beasts were slaughtered and partitioned, and the meat cooked, were such as to render the ration issued so unpalatable that it was often thrown away untouched.

On these accounts more especially it has been argued that a greater extension should be given to the manufacture of concentrated preserved foods, which would be both more portable and palatable, and there can be no doubt that their more general use in the 1st line would admit of a very considerable reduction in the trains hitherto considered necessary. That this has been appreciated in Germany is shown by the establishment at Mayence, in 1879, of a large army manufactory for the preparation of preserved provisions, and their regular periodical issue has now been introduced in peace-time. In any future war we shall, therefore, probably see the supply of the German armies conducted on a system both less cumbersome and less expensive than on the last occasion.

In the matter of forage also similar remarks may be made. The quantity which had to be carried has been stated, and the transport required for it

was enormous, whereas by the substitution of a compressed ration, specially prepared, the weight and bulk can both be reduced immensely. Such a compressed ration was very extensively used by the mounted branches of the Russian army during its campaigns in Turkey, the weight of which was only $3\frac{3}{4}$ lbs., and it was of so portable a nature that a supply for from 4 to 5 days could be carried attached to the saddle without inconvenience to horse or man. Its composition also was so arranged that its necessary exposure in all weathers for lengthened periods had no deteriorating effect, so at least it was reported. Of its supporting and palatable nature a sufficient proof was given by the fact that not only were the Russian horses found to thrive very well on it, but a considerable portion of what was intended for these was reported to have been consumed by the men themselves.

Austria.

Intendance.—In Austria the Economic Section of the War Department has the control of the administrative services of the Army, for which the Intendance, reorganized by Imperial Decree in 1878, is responsible. The duties falling to the latter comprise the supervision and administration of the military chest, of the supply, clothing, and equipment services, and the audit departments. The Intendance officials are attached to the several territorial commands, but are entirely independent of them so far as the supply of the troops, the arrangement of contracts, the administration of the military chest, the charge of stores, and the control of accounts are concerned. In the performance of these duties they act as the delegates of the War Minister, to whom alone they are responsible and answerable in time of peace.

On the other hand, the Chief Intendant of each territorial command acts as the referee of the General commanding it for all administrative questions, and is bound to report to him all the measures taken to ensure the supply of the proper amount of *matériel* and stores required for the troops, and more especially as regards the measures of preparation for an eventual mobilization.

All the officials belonging to the Intendance are under the Chief Intendant of the territorial district to which they are attached, as the delegates of whom they act and to whom alone they are responsible in time of peace for the proper execution of their duties. In war-time, however, this principle is entirely changed, and the several heads of the department, viz., those with the headquarters of the Commander-in-Chief, of commanders of armies, of commanders of the lines of communications, of army corps and divisions respectively, are almost entirely independent one of the other; whereas, on the other hand, they are strictly subordinate to the General on whose staff they are respectively placed.

The *personnel* of this department is as follows:—At the War Ministry an official, ranking as Lieutenant-General, is placed at the head of the Economic Section; while Intendants-General, ranking with Major-General, administer each territorial district. Under them again are Superior Intendants ranking as Colonel, Intendants as Lieutenant-Colonel, and Sub-Intendants of the 1st and 2nd class ranking as Major and Captain respectively. With an army in the field an Intendant-General is attached to the staff of the General Commanding-in-Chief, having under him a Sub-Intendant, whose duty it is to provide specially for the headquarters. To Generals commanding armies, in like manner, are attached a Superior Intendant, assisted also by a Sub-Intendant. With armies in the field the lines of communications are organized into "Army General Commands" under a General Officer, to whom are attached an Intendant-General, a Superior Intendant, and 4 Sub-Intendants for administrative services in rear of the operating army. On the staff of Generals commanding army corps there is also a Superior Intendant (or Intendant) assisted by a Sub-Intendant, one of which latter officials is attached to each division and field supply magazine.

A civil commissioner, assisted by one or two deputies, is also accredited to the headquarters of the Commander-in-Chief, of the army general commands, and of each army corps, who are attached to the Intendance, with a view to acting as intermediaries between the military and local authorities in raising supplies; and in them may be vested the civil administration of the territory occupied in an enemy's country.

The instructions laid down for the guidance of the Intendance officials in war-time are to the effect that they are entirely subordinate to the General under whom they are immediately serving, both in the matter of discipline and in regard to their administrative duties, with the exception only of finance. It is further prescribed that the relation existing between the Chief Intendant and the Chief of the Staff should be of such a nature as to ensure mutual support and to avoid friction. Before taking any measures which may affect the military operations, he must always take his instructions from the Chief of the Staff, whom he must, for his part, inform of all important orders emanating from his department, before submitting them to the General commanding for his approval. In the same manner it is the duty of the Chief of the Staff to communicate to the Chief Intendant all projected movements and operations which will require the co-operation of his department.

The duties of the Intendant-General on the headquarter staff of the Commander-in-Chief are to assist in the distribution of the zones of territory to be assigned to each army for its lines of communication, to control the proposals made by the several armies for the formation of supply magazines in the 2nd line, and to attend to all questions relating to administrative services submitted for his consideration by the General. The Superior Intendant with the headquarters of an army regulates the details of all measures necessary for the execution of the orders received, promulgating the necessary instructions to army corps, informing them of the limits assigned to each for raising requisitions, and the methods to be employed in obtaining supplies, according to the nature of the country in which operations are being conducted. He has also to communicate to the army general command the instructions issued by him for the establishment of magazines in 2nd line.

The Intendant-General attached to the army general command is responsible for the completion of the supply magazines and clothing depôts, and for keeping them constantly stored with the necessary supplies. He also controls the accounts, and supervises the administrative duties on the lines of communication. The Intendants with army corps have, in a similar manner, the control and supervision of the administrative services within that portion of the 1st line occupied by the army corps, and in like manner the officials with lesser units.

Transport.—The defects brought to light in the organization and administration of the Transport service during the first campaign in Bosnia and Herzegovina were made the subject of investigation by a Committee assembled at Vienna in 1879, and presided over by the Archduke Albrecht. The result of their deliberations and report was the introduction in May, 1880, of an entirely new organization for the service.

By it the whole transport corps is now divided into 3 regiments of Military Train, each of which consists of several divisions besides a depôt cadre. Each division again is subdivided into several squadrons and a park cadre, of which the establishment in peace-time are only sufficient for the ordinary services and to provide for efficient training. It is on the basis of these squadrons that the Transport services are arranged in time of war, one being attached to each infantry and cavalry division, one per army corps and army, one for the headquarters of the Commander-in-Chief, and ten for the service of the bridge-train.

The functions of the corps in time of peace are to provide for the training

of its own *personnel*, to afford technical instruction to the reserve men drafted to it from the cavalry and breeding establishments when called up for the annual drills, and to break in the horses allotted to the regiments as remounts. In war time it is charged with the conveyance of the field equipment of the higher commands and their headquarters, of the divisional sanitary and supply columns, of the pontoon train and pioneer reserve park, and it also has to provide *matériel* for the army and army corps train parks and horse depôts. It affords military supervision for the contract and civilian transport employed, and supplies draught horses for guns which may lose their teams, as well as for ambulance wagons. In mountain warfare a portion of it, specially equipped, operates either wholly or in part with pack animals, conveying, besides equipment and provisions, the mountain ammunition parks.

At the head of the whole service is an Inspector-General of Military Train, who supervises it and is responsible for all purely military details both administrative and technical. He corresponds with the War Minister, to whom he reports and submits any proposals he may have to make in connection with transport. He also prepares and keeps distribution lists both for a peace and war footing. To each army is attached a train inspector, who is a Colonel of the Train Corps, and whose duty it is to carry out all orders received from the General commanding, acting as his adviser in all matters connected with his service. He is responsible that all the train under his direction is up to its proper strength, and convinces himself, by personal and constant inspection, that all the units are in a thoroughly efficient and serviceable condition, ready to take the field at short notice. Army corps train commandants perform the same duties, within their own more limited sphere, as the army inspectors, and on the occasion of the train of his corps marching together, the commandant assumes the chief command of the columns. The direction of the divisional train columns devolves upon Field Officers on the unemployed list who have served in the mounted branches ; but, though they assume command of the columns on the march, and are responsible for keeping them together, they have no control whatever over the organization and interior economy of the several units.

In peace-time each of the regiments is commanded by a Colonel, and each of the divisions by a Field Officer or Captain of the Train, who become Army Train Inspectors and Army Corps Train Commandants of the armies and army corps respectively into which the greater number of the train units under them in peace-time are incorporated upon mobilization. The Officers of the train form a special corps, and are obtained in part by promotion from the ranks, partly from students of the Military Train Department of the Infantry Cadet School at Prague, and partly by the transfer of subaltern Officers from the cavalry and field artillery. On mobilization, the increase required to complete the establishments is provided for from the reserve list of Officers, from amongst Officers serving in the cavalry and field artillery, and, lastly, from retired Officers who have served in the mounted branches, their selection and distribution being arranged for beforehand and recorded in the mobilization lists in time of peace.

The men are taken from amongst those becoming liable for service in the ordinary course under the existing military law, such as are accustomed to the charge of horses and wagons being selected by preference. Some also are obtained by means of transfer from the cavalry and breeding establishments in a certain fixed proportion. On mobilization the reserve men and those on furlough are called up.

The organization and subdivision of the 3 regiments of train and their depôts will be found fully dealt with in No. CXIII of the "Journal" of the Institution, embodied in a paper read in 1881 by Lieutenant John Ross of Bladensburg, as well as the mode of expansion on mobilization and the war establishments of the several units then called into existence. It will, there-

fore, be unnecessary to enter any further into detail regarding these points, or to do more than recall the fact that a certain proportion of regimental transport, termed the small train, for the conveyance of ammunition, provisions, and baggage, is attached to each unit, and is in the permanent charge of the troops themselves, the detail of this being also given in the paper already referred to.

Supply.—The Supply service in the Austrian Army was reorganized by an Imperial Order issued in 1878, which laid down the principles for regulating the supply of armies in the field with great exactitude and in considerable detail. The Military Supply Establishments provided for by this are divided under two heads, viz., the Permanent Military Supply Establishments and the Field Supply Establishments. The former serve as stores and reserve magazines, forming also in time of war movable magazines for the provision of the armies in the field. They are divided into military supply and supplementary magazines. The Empire is divided into 35 supply districts, forming subdivisions of the 15 Intendance provinces, each of which districts has a military supply magazine with supplementary ones as required. Those established at the several Intendance headquarters are termed Chief Supply magazines, and by their staff is arranged the details for mobilization and the formation of the Field Supply Establishments. They are under the military commanders of the province, through the Intendance Department, their *personnel* being composed of officials and men forming the supply branch.

The establishment of military supply officials is on a peace footing only 257 of all grades, furnished from one-year volunteers, non-commissioned officers, and the military academies. This number is increased on mobilization to 909, by calling up officials borne on the reserve and retired lists, by transfers from the Landwehr and the promotion of probationers. Of other ranks the peace establishment is 1,080, which is increased on mobilization to 9,287, by enrolling tradesmen from the Ersatz reserve, including all the available bakers, by transferring from the Landwehr all those formerly in the reserve of the Supply Department, and by calling up those tradesmen, principally bakers, who are liable to military service.

On mobilization the permanent establishments serve to form and equip the field supply establishments for the mobilized army corps, and provide them with the necessary stores; to furnish live stock and supplies in the peace quarters of the troops; to supply the general and other headquarters and mobilized troops on the march, as well as the étappen stations within the radius of concentration, and, lastly, to collect the supplies required to be sent forward to the field supply establishments during the course of operations. Such of the magazines as become unnecessary through the troops having been withdrawn from their districts are closed, while those situated nearest to the theatre of war are converted into chief supply depôts.

The several columns and establishments so formed are regularly[1] grouped, as follows, according to their relative positions, with regard to the army which it is their business to supply:—

1st line of field supply establishments—

The supply columns.
The provision columns.

2nd line of field supply establishments—

1st group: The field supply magazines.
2nd „ The reserve magazines.
The reserve bakeries.
The cattle depôts.

They are formed partly on mobilization, and partly as required subse-

[1] *Vide* No. CXIII, Journal, diagram, p. 301.

quently. The supply columns are technically termed the reserve supply establishments of the 1st line, and number 64, of which 42 are allotted to infantry divisions, 2 of them being specially adapted for service with the divisions equipped for mountain warfare, 5 to cavalry divisions, 13 to army corps, and 3 to armies. Each of them is divided into a column for supplies in kind, and a column of live stock, and carries a four days' supply, including meat, together with corn rations for the same period, and two days' hay. The transport is provided from the military train, civilian carriage being employed for the hay. The column of supplies in kind is formed into sections in such a manner that each shall contain provisions for one day for the troops, and the wagons are loaded so as to carry one day's issue for about 1,000 men, which is ordinarily more than adequate for a battalion of infantry or a regiment of cavalry in the field. The mountain columns are organized in a like manner, carrying a four days' supply, and being divided into sections. They are furnished exclusively with pack transport, so as to admit of their following the troops on all occasions. A supply official is placed at the head of each column and forms, with a controller, the administrative and financial board. The Officer in command of the train regulates the movement, the column being ordinarily kept from 5 to 10 miles in rear of the troops. The function of these columns is to provide supplies to the provision columns, included in the small train, or in some cases directly to the troops themselves. The stores carried by them are renewed, either by means of requisition, or from the field supply magazines in rear.

The provision columns, which the supply columns serve to renew, are formed from the provision wagons of the several units, of which each infantry regiment has 6, cavalry regiments 13, batteries field artillery 3, horse artillery 4, battalions engineers 4, and companies pioneers 1. These carry two days' provisions, not including meat, but they are accompanied by cattle sufficient to furnish meat rations for three days. As, however, these columns have not sufficient mobility to remain on all occasions with the troops, there is also a special "fighting train," which follows its respective units, at all times carrying one day's meat and reserve of biscuit. The men themselves carry, besides two days' rations of biscuit, one reserve ration, termed, as in the German Army, the "Eiserne Vorrath," consisting of sausage or preserved meat. Under exceptional circumstances this may be raised temporarily to four days' preserved provisions and two days' biscuit, and cocoa may also be added in tablet form. These are carried by the infantry in the pack, and by mounted branches on the horses. Forage is carried for two days, with one-third ration of oats in addition, with the "fighting train." With the provision columns are two days' more, and four days' with the supply column. The sum, therefore, of the provisions with an infantry division, including live cattle, is as follows:—Provisions without meat eight days, meat eight days, reserve provisions without meat, one day; Eiserne Vorrath, one day. Forage for eight and one-third days.

The field supply magazines are established for the purpose of renewing the provisions consumed in 1st line, when it is not possible to do this on the spot. Usually each army corps will have its field supply magazine, the establishment of which is fixed at six days' supply for 50,000 men, and forage for 10,000 horses. These are not necessarily stored together, but may be preferably divided between several places échelonned along the line of communication. The provisions and stores are drawn as far as possible from the neighbouring district, the rest being obtained from the establishments in rear. To each magazine are attached a field bakery and butchery depôt, the whole being under a board of direction, receiving orders as to their formation and the movement of the several establishments from the General Officer commanding the army communications. The field bakery consists of 80 ovens subdivided into 4 sections, horsed by hired draught, and they are

ordered to be employed only when the supply of bread from the 1st line cannot be obtained by other means. The butchery depôt contains live stock for six days' consumption. The train of the field supply magazines is under the commandant of the section of military train attached, who is subordinate to a Field Officer in general military charge. The field supply magazines are included in the 1st group of military establishments of the 2nd line.

The function of the reserve supply magazines is to collect stores of provisions at convenient points for feeding the field supply magazines, which send trains of wagons to take them up. The usual means employed for obtaining the necessary provisions is purchase and requisition, resort being had to the permanent magazines in rear only when these sources fail to ensure the necessary supply. They are established, therefore, with special reference to facility of communications both to the front and rear. There is no fixed number of these magazines, neither is there any regulated establishment of provisions to be maintained, but they are provided for generally in the proportion of one to every two army corps.

Reserve bakeries are also established to provide for the supply of biscuit, their number and the quantity of ovens employed being influenced by circumstances. Cattle delivery depôts are established in rear again of the reserve magazines, where cattle for slaughter are collected, the ordinary proportion being one depôt per army. All these belong to the 2nd group of the reserve establishments of the 2nd line.

March and étappen magazines are formed on the line of communications at intervals of from three to four marches, for the purpose of supplying troops on the march, and storing the supplies drawn from the country. They are established under the orders of the General commanding the army communications, a proportion of the field supply *personnel* being placed at his disposal for the purpose. Such as are of a purely temporary nature, rendered necessary by the march of large bodies of men, as during the period of concentration, are termed march magazines, and are not maintained beyond the period during which they are required by special circumstances. Those which are required to be permanently maintained for the services of supply on the lines of communications are termed, as in Germany, étappen magazines.

In a general instruction it is laid down in the Austrian regulations that on territory being occupied by the troops during the course of operations, the resources actually available should in the first instance be utilized. The supplies to be found in the radius of territory to be assigned to each unit of the army should next be collected, and, finally, when this source fails to provide the necessary supplies, these must be brought up from the rear by means of convoys. It is prescribed that everything useful to an army in the field may be taken from an occupied country, but it is pointed out that it is not possible to lay down fixed rules as to how the greatest amount of advantage is to be drawn from it. The political and military situation, the industrial, commercial, and agricultural resources of the country, the requirements of the army, the nature of the communications and means of local traffic, the favourable or unfavourable disposition of the population, are all quoted as important elements which must necessarily be taken into consideration. The utmost care and moderation are therefore enjoined, both in the ordering and execution of requisitions, which are directed to be arranged for by Intendant officials in concert with civilian commissaries, who would precede the troops for this purpose by several marches, whenever circumstances will permit of it.

The responsibility for the supply of the troops in the 1st line rests entirely with the General commanding, who decides upon the manner of supply, and the way in which the several methods should be combined. In concert with the Intendant official he defines the limits of the *rayons* to be allotted to the several army corps for the purpose of levying supplies by requisition, and he

instructs the General in command of the communications regarding the bringing up of supplies from the reserve establishments. The latter Officer provides for the punctual execution of the orders received by him, and is responsible for the disposition of the reserve establishments in such a manner as to be best situated for furnishing the supplies required, and for their being kept always complete in stores.

Comments.—From the foregoing description of the intendance, transport, and supply, as introduced into the Austrian Army during the last few years, it is evident that the systems in vogue in Germany have been placed largely under contribution in framing the Austrian regulations, as it is only natural they should be, after the success with which they have stood on several occasions the rough test of war on an extensive scale. The adaptation of these systems has been, however, by no means a servile imitation, for in many particulars the Austrian services differ materially from those of Germany, important modifications having been introduced, more particularly in the system of supply.

As regards the intendance, the principle of strict subordination to the military commanders in time of war is insisted upon, while the responsibility of the latter in all matters of supply is undivided. Particular stress is also laid upon the mutual relations which should exist between the head of the Intendance and the Chief of the Staff, as being, as it must be, of the utmost importance. The affiliation of civil commissioners, with a view to acting as intermediaries in the work of raising supplies by requisition, and in the administration of the enemy's territory occupied by the troops, is a step calculated to diminish friction in these matters, and to relieve the military authorities of considerable extra work which falls more properly within the province of civilians.

In the matter of transport, although the enormous difference between the establishments of the train on a peace and war footing must be a source of great difficulty upon mobilization, the prescribed measures for forming from the regiments the several columns and establishments to be created are arranged in such a manner as to facilitate this task as far as possible. The organization of the train by squadrons has been arranged with a view to their being utilized in time of war without losing their individuality, a point of no small importance, and it would appear to be an improvement on the German organization. Another important point of difference is to be noticed in the regularly organized regimental transport service, for the carriage of provisions, the absence of which has on many occasions been felt in the German Army, though in the campaigns of 1870–71 it was in great part supplied by the informal appropriation of civilian transport by the regimental units. The introduction of specially organized mountain squadrons, equipped for pack transport, is also a particularly noticeable point in the Austrian organization. Recognizing the difference in the service which their troops are frequently called upon to perform in mountainous country in which wheeled transport is not practicable, and influenced more particularly by the difficulties experienced in Bosnia, it was wisely decided to include in the reorganization of the train permanent cadres for no less than twenty mountain squadrons, and although up to the present but few of these have been formed, those even now available must facilitate immensely any operations undertaken by an Austrian force on her rugged frontier territory.

The organization prescribed for the supply service is very practical, and the intermediate transport of provisions provided for by the regimental train admits of the separation of the troops from their divisional columns, without the man being overweighted by carrying extra rations, which cannot be utilized excepting in extreme cases. This would appear to be an improvement over the German system, by which the soldier carries at all times three days' reserve rations, weighing together nearly 7 lbs. A further improvement,

however, remains to be made in the substitution of preserved meat for the cattle, which are prescribed as forming a part of the regimental provision columns, and which cannot but be detrimental to the rapid movement usually necessary for detached bodies. In the same way the substitution of manufactured forage rations would admit of a further reserve of forage being carried without extra bulk, which is very desirable, the amount at present provided being insufficient. The divisional supply columns are also probably better as a unit than the German army corps provision columns. The organization in several lines and groups of the reserve establishments, each under distinct military command, is calculated to facilitate regularity of supply, but the apparent completeness of the arrangements must be submitted to the test of actual warfare before it can be seen how far the Austrian services can be compared with the German in the matter of efficiency.

France.

Intendance.—One of the results of the Franco-German War was to prove the necessity for reform in the administrative services of the French Army. The Intendance had always been a *corps d'élite*, and in it were to be found a large number of Officers distinguished alike for their education and knowledge; but from the opening of the campaign of 1870, it was seen that the administrative branches of the Army were not equal to the strain of a great war, a fact which became more painfully evident as the campaign proceeded. The general verdict was a wholesale condemnation of the Intendance and the subsequent demand for its complete reorganization. With a view to preparing the way for this, the subject was referred for enquiry to a committee, which investigated the matter most thoroughly and brought to light still more clearly than before the shortcomings of the departments during the war. As the facts came to be collected and recorded, the immense difficulties under which these had laboured were also brought to light, and impartial observers remarked that, although the failure had been complete, there were many good points in the actual system, had it only been fairly worked.

The principal directions in which the failure was most observable were—1st. The incomplete organization of the administrative services and the insufficiency of their effective; 2nd. The wrong disposition of the provision columns in the field and the absence of movable magazines on the lines of retreat; 3rd. The capture by the enemy of provision trains and of the administrative *personnel;* 4th. The absence of reserve transport for employment in cases of necessity; 5th. The difficulty of distributing provisions to the disbanded troops; 6th. The uncertainty as to the precise position of halting-places and the want of cooking utensils, which were left with the packs on going into action, and generally fell into the enemy's hands in case of a reverse.

The constant recurrence of one or other of these, and very often of several combined, made any regular distribution of provisions impossible, while it repeatedly happened that when issued there were no means of cooking them. For many of these shortcomings the administrative services were in no way responsible, while others were due to the faulty system of divided responsibility between the military commanders and the heads of the Intendance. The responsibility of planning, directing, executing, and distributing was left under this system entirely with the Intendance, which was quite unequal to the task. In the first instance the troops took the field half mobilized and deficient in *personnel* and train, while the first actions diminished still further their resources, for the whole of the administrative *personnel* and train of one corps, together with the greater part of another, fell into the enemy's hands at the Battle of Wörth early in the campaign. Accustomed to absolute dependence on the Intendance and upon its regular train for supplies, the whole machinery was thus broken down, and the confusion became hopeless, notwith-

standing the utmost efforts of the Intendance Officers, so that the troops became absolutely dependent upon the charity of individuals for their daily bread.

Comparing what occurred on this occasion with the system in vogue in other armies, it is evident that, in the first place, had the responsibility for the supply of the Army rested with the military authorities, it would fall to the General commanding to see that the supply columns and administrative services were so placed as to be secured from falling into the enemy's hands, whilst measures would have been taken in case of necessity for supplying the troops regularly from the rich country through which their retreat subsequently lay.

Untold privations ensued, caused by a constant recurrence of defeat, marching and countermarching, which the Intendance, insufficient in numbers and with scanty means at their disposition, were unable to obviate. Later on, however, when a pause occurred, the bitter experiences which had been undergone led to great changes and improvements in the supply services, and it was sufficiently proved that, with an improved and properly organized system, the actual Officers of the Intendance would be equal to any calls that might be made upon them.

The radical defect, already adverted to, was the divided responsibility, and it was upon this point that the discussions of the committee principally turned. The question was at the time the committee sat considered urgent, yet during the succeeding seven years it was referred from one committee to another without any decision being come to until 1880, when a Bill on the administration of the Army was brought in, adopted by the Senate after prolonged discussion, and sent down to the House of Deputies with every prospect of becoming law. While, however, it was under discussion General Farre, the then Minister of War, suddenly introduced a Bill of his own. Both were referred to a committee, which rejected the latter and reported in favour of that already voted by the Senate, which rested on the principle of the complete subordination of the administrative to the military authority. Owing to constant changes of Government, it was not until the 16th of March, 1882, that the new law was, with certain modifications in detail, adopted.

By it the commanders of army corps are made directly and entirely responsible to the Minister of War for all the administrative services and establishments within the districts affected to their respective corps. The heads of the Intendance, as of the other services, are directly subordinated to him, and correspondence by them with the War Department is directed to pass through him, excepting such as relates to pure detail. The heads of departments attached to a division occupy a similar position towards the General commanding it. In the case of an army being formed the Minister of War delegates, within the necessary limits, his administrative powers to the General commanding it, to whose staff are attached superior Officers of the several services, with whom the heads of departments of army corps correspond under the same conditions as they do with the Minister in time of peace. These superior Officers exercise, under the authority of the Commander-in-Chief, a general supervision over the services of the army corps.

By the new law also the Medical service, formerly subordinated to the Intendance, is formed into a separate department, thus relieving the latter of much detail work, and giving to the Medical branch an independence highly desirable from many points of view. The Intendance will, however, still continue to disburse all moneys, and to furnish the hospitals and ambulances with material and supplies under the military authority.

Besides the Intendance and Medical departments, the administrative services include artillery, engineers, and gunpowder, &c., each of them being organized on a similar principle, which involves a separation into direction, executive, and control. Of these the latter is responsible to the

Ministry of War alone, and has for its object to guard the interests of the Treasury, acting by examination of accounts and unexpected inspection of supplies.

As regards the relations with the military authorities, the commander of an army corps has under his direct command the troops of all descriptions, as well as all the services and establishments attached. The directors of these are under his immediate orders and correspond directly with him. He is responsible that the troops are provided with everything necessary and for satisfying himself that the supplies in the corps magazines are of good quality and proper quantity, ready for immediate issue and use, and he has to acquaint the Minister in good time with the requirements of the army corps.

On the formation of an army, the Minister delegates to the General commanding his administrative powers, within the necessary limits, and the latter then represents him as regards the army corps commanders.

The corps of Military Intendance provides for the services comprised under this head, and has a gradation list of its own. It is under ordinary circumstances to be recruited from Captains, *Chefs de Bataillon*, *Chefs d'Escadron*, and Majors of any branch of the Service and administrative Officers from the executive branches, who have to pass a qualifying examination. On mobilization the cadres are to be completed from Intendance Officers of the reserve and territorial army, fulfilling certain stipulated conditions.

The several grades are as follows: 1. "Adjoints," or assistants, ranking as Captains, who in peace-time are employed exclusively in the offices, and are not, under any circumstances, to exercise the functions of direction prescribed for the senior grades.

2. Sub-Intendants of the third, second, and first class, holding respectively honorary rank as Major, Lieutenant-Colonel, and Colonel.

3. Intendant, ranking as Major-General.

4. Intendant-General, ranking as Lieutenant-General, the rank being in each case after the combatant Officers of the respective grades.

The establishment is fixed at 387 in all, amongst them being 7 Intendants-General and 30 Intendants.

The immediate duty of these Officers is the direction of the services of supply, clothing, camp equipment, &c., in the execution of which they do not immediately participate, having under their control for this purpose a separate corps of Officers. These are the "Officers of Administration," forming an entirely distinct corps, the grades of which are "Assistant" of the second and first class, "Officer of Administration" second and first class, and "Principal Officer of Administration."

The corps is recruited exclusively from *Adjutants-élèves* of administration, having served at least a year as such, and who are themselves taken from special schools. It is completed on mobilization by Officers of the same service belonging to the reserve and territorial army, who fulfil certain required conditions.

The establishment numbers 1,565, who are divided into four branches, a fixed proportion of each rank being included in each. These branches are Intendance Offices, Supply, Hospitals, and Clothing and Camp Equipment, in one or other of which the Officers serve, as ordered by the Minister.

The Control is also to have a gradation list of its own, without having any assimilation with the Officers of the Army as regards rank. The establishment is fixed at 80, the several grades being as follows:—

1. Assistant Controllers.

2. Controller second class: to be recruited from amongst military Sub-Intendants second class, Lieutenant-Colonels, *Chefs de Bataillon*, *Chefs d'Escadron*, and Majors of all arms, and also from Sub-Intendants third class qualified for promotion.

3. Controller first class: from military Sub-Intendants first class and

Colonels ; also from Lieutenant-Colonels and Sub-Intendants second class of at least two years' seniority.

4. Controller-General second class: from military Intendants and Major-Generals ; also from Sub-Intendants first class having at least three years' standing as such.

5. Controller-General first class: from Lieutenant-Generals and Intendant-Generals ; also from Major-Generals and Intendants having at least two years' seniority.

After the first formation of the corps, it will be recruited by competition amongst Sub-Intendants second class, *Chefs de Bataillon*, *Chefs d'Escadron*, and Majors of all arms.

Although eight months have, at the time of writing, elapsed since the promulgation of the new law on the administration, the consequent instruction by the Minister of War as to the details of its execution has not been yet issued, nor the first appointments to the newly-created department of Control made.

Transport.—In the French Army the transport services are provided for by means of special formations with a strictly military organization, supplemented as may be necessary by auxiliary trains. The artillery and engineers have their own specially organized train companies for the performance of the transport services required for these arms, and the units of all arms have a certain proportion of wagons in regimental charge for their own use. The remainder of the transport services, including the whole of the administrative services for supply and other purposes, are furnished by the Military Train, a special formation organized into squadrons and companies.

This corps was inaugurated as far back as 1807, since which time its organization nas undergone many changes and modifications, but the principles upon which it was instituted remain still in force. Further modifications are no doubt necessary to render it equal to the requirements of the present day, but the principal of these is that its effective should be raised. This is more particularly the case as regards Officers, the cadres of which at their full strength are barely sufficient for the duties of supervision and administration. In time of war the effectives naturally decrease rapidly, and in place of being able to supply Officers to assist in the creation and supervision of auxiliary formations, the regular companies are themselves left lamentably under-officered, with the unsatisfactory results to be expected from such a state of affairs.

Not only was this the case in 1870, where an enormous strain was put upon this service on account of the large forces that were in the field and the extensive casualties sustained, but equal inconveniences have arisen from the same cause during the late operations in North Africa.

The Military Train is composed of 20 squadrons, each of which is divided into 3 companies, numbered 1, 3, and 5, which are augmented on mobilization so as to form 2 each, one of the 6 being a depôt company. The squadrons are attached to the several army corps, the 20th being told off to the military government of Paris, while the 19th, although attached to the Algerian corps, is stationed in France. The companies are divided into mounted and light, the former being equipped for ordinary service, and the latter provided with pack equipment. Mixed companies are composed in part of each, and have an increased establishment of men and horses ; and of these there are 12 detached to Algeria for service in that country.

The establishment of a squadron on a peace footing is 1 commandant, 17 Officers, 114 non-commissioned officers and men of cadres, and 156 train soldiers. On a war footing after subdivision into 6 companies, each of these consists of 4 Officers, 44 non-commissioned officers, tradesmen, &c., and 256 men, or in all 304.

The establishment of the corps on a peace footing is, in the 20 squadrons

in France, 369 Officers, 2,400 non-commissioned officers and cadres, 3,120 men; and in the 12 mixed companies in Algeria, 51 Officers, 532 non-commissioned officers and cadres, and 3,072 men; making a grand total of 9,744 of all ranks. On a war footing the 20 squadrons alone, calculated by the strength of companies already given, would give 480 Officers, 5,280 non-commissioned officers and cadres, and 30,720 men, or in all 36,488, which, with the 12 companies in Algeria at normal strength, makes a grand total of over 40,000 of all ranks. The disparity, therefore, between the peace and war footing is enormous, and is as great in the matter of horses, of which the peace establishment is only 6,470.

As regards the Officers there are 180 on the reserve list, and the other cadres and men required to complete would be drawn partly from the reserve and partly from the cavalry, the residue being made up from men *en disponibilité* who have not served. Of these, 23,500 are taken annually from the year's contingent for the auxiliary services, eight in number, but men from this source have the disadvantage of not having received any training, which is particularly objectionable in a service such as the train. The number of horses required to complete all services to a war footing is over 97,000, which would be obtained by requisition, to facilitate which a law was passed in 1877 authorizing an annual muster and classification of all horses available, when the prices to be paid for them are fixed. In the same way a classification is made every third year of all wagons and vehicles appropriate for army service, which can be employed for the formation of auxiliary transport columns, to be organized on mobilization for services in rear of the operating army, or to supplement the regular train attached to it.

In the field the services to be performed by the Military Train include the removal of the wounded from the field of battle, the carriage of the sick and wounded from the ambulances to the field hospitals, the transport with columns of men unable to march, and of the *matériel* and supplies in charge of the Intendance.

For these purposes the several companies of the squadron affected to each army corps are permanently told off for special duties with the troops composing it, in the following manner: No. 1 Company horses the ambulance service, supply column, treasury, and postal wagons of the 1st Infantry Division; No. 2 Company furnishes half the supply column of the army corps headquarters, and part of its ambulances; No. 3 Company supplies the 2nd Infantry Division as the 1st Company does the 1st Division; No. 4 provides for the treasury and postal service of the army corps, and for the cavalry brigade, horses the wagons of the telegraph sections of the 1st line, the remaining half of the army corps supply column, and the reserve of clothing and equipment; No. 5 horses the light ambulances of the whole corps.

From the 6th or Depôt Companies the engineer parks and independent cavalry divisions are provided.

The head of the Military Train is the Commanding Officer of Artillery, but practically, although not directly, it is at the orders of the Intendance Officers, so far as the execution of services is concerned.

In the territorial army a squadron of train has been instituted for each region answering to the numbers of army corps in the active army, but, though the cadres have been formed, they are far from complete, there being only some 180 Officers borne on the list out of the 258 required.

As has already been noted, regimental transport is attached to the units of the several arms for their own immediate services. These are the carriage of Officers' baggage, tools, archives, provisions of the 1st line, and reserve of clothing. The necessary wagons for this purpose are provided by the artillery manufacturing departments, and are inspected annually by an Officer of the artillery. The corps entitled to regimental transport are as follows:—

Infantry regiment of 3 active battalions : 4 two-wheeled one-horse carts for Officers' baggage, of which one is for the staff ; 3 ammunition carts ; 2 for pioneers' tools ; 1 for reserve of clothing and necessaries ; 17 provision carts ; 3 canteen carts ; 3 bât animals with medical panniers ; making a total of 27 one-horse regimental carts, besides those of canteen men. The 4th battalion has only one cart for baggage, and 1 bât animal.

Battalion of Chasseurs : 10 one-horse regimental carts and 1 bât animal.

Regiment of Cavalry : 15 two-horse wagons ; 1 four-horse field forge ; and 3 bât animals.

Artillery of Division, comprising 4 field batteries : 20 two-horse wagons.

Artillery of Army Corps, comprising 8 batteries : 37 two-horse wagons.

One bât animal is allowed to each battery.

Company of Engineers : 2 one-horse carts.

In time of peace only one cart per battalion is allowed to be kept in use, the rest being stored in charge of the *Vaguemestre*. In war-time a corporal and 30 men of the regiment are attached to the transport under him for the purpose of driving and looking after it. The horses required for it on mobilization are obtained by requisition in the same manner as those for the train.

Supply.—In France the ordinary supplies are obtained either by direct agency or by contract, the former method being employed in the more considerable garrisons and fortified places, where it is necessary to maintain permanent magazines of provisions. In time of peace bread and meat are issued, and 20 centimes allowed daily towards the mess fund or *ordinaire* for the purchase of groceries, the ration being fixed as follows since 1873, when it was increased somewhat :—

Bread 26·5 ozs., or biscuit 19·4 ozs.
White ditto for soup 8·8 ozs.
Meat (uncooked) 10·6 ozs.
Vegetables 3·5 ozs.

In time of war the full ration, including groceries, &c., is issued, being classified as follows :—

Bread ration—Bread	26·4	ozs.
or Biscuit	25·4	„
Meat ration—Preserved meat	7	„
or Salt	10·5	„
or Bacon	8·8	„
Petits vivres, comprising groceries, &c.—Compressed vegetables	2·2	„
Salt	·5	„
Sugar	·7	„
Coffee	·5	„

Wine, spirits, or beer is issued exceptionally.

The forage ration varies as follows, according to the class of horse :—

Oats—Artillery horses	12·7	lbs.
Cavalry and Officers'	10·58	„
Light cavalry	10·47	„
Arab horses	9·92	„
Hay	8·82 lbs. to 6·61	„

By an order issued in 1879 the troops on leaving garrison take with them a certain proportion of provisions, which are carried by the infantry in their packs, and by the mounted branches on their horses, viz. :—

2 days' bread.
2 „ biscuit.

4 days' *petits vivres.*
5 rations preserved meat in tin cases.

The bread and two days of *petits vivres* are supposed to be consumed during the journey by railway, and are renewed on debarkation for consumption the two days following. After this and during the course of operations two days' biscuit and groceries and the tin with two rations preserved meat only are carried.

The cavalry carry one day's provisions only with two and a half days' oats and two days' hay during concentration, and subsequently half a day's oats. The artillery and train carry during concentration three days' oats and two of hay, and afterwards one day's oats.

Next in succession for supply comes the regimental transport, classified as the 1st *échelon* of the 1st line of supply. By it is carried 2 days' biscuit, *petits vivres*, and oats, also 1 day's preserved meat. The divisional column comes next, carrying 4 days' biscuit, *petits vivres*, and oats, with 2 days' preserved meat and brandy. Each column is divided into 4 sections similarly laden with one-fourth the above quantities.

The *personnel* of each column is as follows :—

Administration.

Officers of Supply	4	
Tradesmen, including 16 bakers	88	
		92

Train.

Officers	3	
Non-commissioned officers and men	247	
		250
Total.....		342

with 397 horses and 139 carriages, of which 66 are requisitioned.

These columns convey supplies for the several constituted divisions exclusively, those for army corps troops not included in these being carried by army corps supply columns. These are similarly organized in four sections, each of which carries 4 days' provisions complete. They are considerably larger than the division columns, the effective being as follows :—

Administration.

Officers of Supply	5	
Tradesmen, bakers, &c.....	69	with column
Do. do.	130	in reserve
Total.....	204	

Train.

2nd Company	Officers of Supply.....	5	including Commandant.
	Non-com. officers and men	171	of 2nd Co. Train.
4th Company	Officers of Supply.....	4	
	Non-com. officers and men	175	
		355	
Total		559	

with 543 horses and 165 carriages, of which 78 are requisitioned.

The total complete rations consequently carried are as follows :—

	Preserved meat.	Petits vivres.	Biscuits.	Oats.
	Days.	Days.	Days.	Days.
In pack	2	2	2	
Regimental Transport	1	2	2	2
Division and Army Corps Supply Columns	4	4	4	4
Total	7	8	8	6

besides 2 days' brandy with supply columns.

The cavalry carry only 7 days' *petits vivres* and biscuit, and 5 of preserved meat, but have 6½ days' oats. The artillery and train have the same, with the exception that they carry 7 days' oats.

Comments.—One of the most noticeable facts on studying the Intendance arrangements during the campaign of 1870–71 is that they relied altogether, in the first place, upon their provision columns as at that time constituted. The result of this was to retard considerably all movements, and to throw all the supply arrangements altogether out of gear upon any sudden change of direction, which unfortunately became necessary only too often, while changes were frequently made when no necessity existed. On the retreat after the disastrous Battle of Wörth, on the 6th August, the 2nd Division, 1st Army Corps, was four entire days without receiving any regular issues, and then only a half ration of bread was distributed—and this was in their own country. In the reorganization which has since taken place, the arrangements already adverted to have been introduced, no doubt, with a view to facilitating the adoption of an opposite course.

An instruction has further been issued, prescribing that wherever such a course is possible, the troops in the field are to be fed by the inhabitants. Where this is not feasible, the columns of the 1st line are ordered to be utilized, being refilled at once with all possible speed. In principle the regimental columns are used for the daily requirements refilling from the division columns. These in their turn are completed from the supply magazines to be established in the vicinity of operations and stored by means of purchase or requisition, at the railway provision depôts, or from supplies forwarded from these by rail. To ensure regularity in distribution an Officer of the Staff as well as an Intendance Officer is directed to attend at the issue to regimental provision Officers.

In principle, at least, the organization of the Intendance and the system of supply have thus been radically changed in France since the late war, but it is not of altogether happy augury for the working of the new order of things that these changes have taken upwards of ten years to complete. If, as now constituted, the several services are compared with those of Germany, the acknowledged Continental model, we shall not notice much to find fault with. But if we go beyond the sphere of paper, the comparison would be a sorry one indeed, and the years which have been in great part wasted, whilst discussing the law of the future as to the status and responsibilities of the administrative departments, might have been so utilized as to have ensured, ere this, adequate and efficient services for the administration and supply of an army in the field. It must now be some time before the new order of things as regards the Intendance, the introduction of which was strenuously opposed up to the last, will be loyally accepted by the Officers concerned, and still longer before combatant Officers in command will have become thoroughly

habituated to the exercise of the responsible duties imposed upon them by the new law. Should a campaign on a large scale be forced upon the country before this has come to be the case, it is more than probable that the confusion might be as complete as it proved on the last occasion, the more so that far larger bodies of men would be called into the field in the first instance.

As regards the transport of supplies, the arrangements introduced, by which a certain proportion of provisions is carried by the soldier, and a further supply by a purely regimental transport, are such as cannot but operate favourably upon the general supply arrangements, while they require no course of probation. From the moment that the troops take the field, carrying their immediate supply of provisions with them, independent of the regular transport and administration services, there is a distinct and material gain. The regular train organization remains as hitherto, excepting in the matter of establishment, and in this a further increase is not only desirable but absolutely necessary. Even in Algeria, where companies are maintained at a war footing, and specially organized with pack transport suitable to the country in which they are required to operate, there is a constant outcry as to the low effective maintained, especially in Officers, which acts most detrimentally on expeditions such as that in Tunis in 1881.

Russia.

Intendance.—In Russia the Intendance is entrusted with both the direction and control of all matters connected with the clothing, supply, and payment of the troops and military establishments. It is under the supreme direction of an Intendant-in-Chief attached to the Ministry of War, who is assisted by two superior Officers of the Department. The service is divided into six sections, as follows :—

1st section : Clothing and equipment.
2nd „ Pay.
3rd „ Supply.
4th „ Military law.
5th „ Registers, musters, &c.
6th „ Disbursements and accounts.

The whole of the Russian Empire, including European Russia, the Caucasus, and Russia in Asia, is organized into 15 military regions. To each of these is appointed an Intendant, who is responsible for the supply and payment of the troops and establishments, including hospital material. In all executive matters he takes his orders from the military commander of the region under whose authority he acts, but in other respects he is responsible to the general direction as represented by the Intendant-in-Chief. His attributes embrace the subjects dealt with by three separate sections placed under his direction, viz. :—

1st section : Clothing and equipment, also material of train and ambulances.
2nd section : Supplies, comprising provisions, forage, and medicines.
3rd „ Pay, lodging, &c.

To ensure the proper control of these several services, a committee is formed in each region, composed of the Intendant, his assistant, and the heads of the several sections.

In the field the Intendance provides for the supply, for all purchases, and the equipment of local and temporary magazines and hospitals. The whole service is placed under an Army Intendant, specially appointed, who is assisted by a superior official and staff. Under him with the several units are Army Corps and Divisional Intendants, and also a Commandant of the Intendance transport forming the movable magazines.

The Army Intendant derives his authority from the Commander-in-Chief,

and from the information furnished by him, the Minister of War, and the Chief of the Staff, he draws up a general scheme of supply calculated to meet the circumstances of the operations which he submits for the approval of the Commander-in-Chief. He has also the direction of the Intendance transport placed under his orders, in communication with the Chief of the Staff and the Commandant of Communications. When requisitions are to be levied he is responsible for their proper distribution and orderly execution.

Intendants of army corps, divisions, and detachments carry out the orders received by them, and are responsible for the direction and supervision of the several services as regards the units to which they are respectively attached. A Staff Officer is specially deputed for the purpose of keeping on the map a correct state of troops, magazines, depôts, and hospitals.

The clothing is furnished through the Intendants of regions, in each of which is a manufactory working under him. About half a million complete sets of uniform are kept in reserve stores for issue on mobilization, and during the last war in Turkey the manufactories turned out besides upwards of a million sets.

Transport.—The Russian Army is the only one that provides altogether regimentally for the *matériel* and *personnel* of its transport services. In each regiment is a non-combatant company, comprising hospital attendants, artificers, train soldiers, and Officers' servants, the establishment of which in peace is 202 non-commissioned officers and men, and in war 227. In this company 1 non-commissioned officer and 20 men are at all times present, and this number is increased on mobilization to 2 non-commissioned officers and 46 men, by calling up those on furlough. They are clothed in the same manner as the regiment, but without facings to their uniforms. In the same manner the establishment[1] of Government regulation vehicles for each regiment and other tactical units are permanently attached to and in their immediate charge, being maintained by means of an annual contingent allowance granted to the commanding Officer. These vehicles consist of small-arm ammunition wagons, provision wagons, ambulances, apothecaries' carts, and tool wagons. They are horsed by the Intendance Department, only the provision wagons being so in time of peace and then only with two horses, whereas in time of war one-half of them are four-horsed. On mobilization they are brought up to the war effective by calling up the men on furlough, and the horses completed from those registered beforehand.

This organization was the result of a law promulgated in 1876, the steps for giving effect to which were to be commenced the following year, and it was calculated that four years would be required to give full effect to it. In the meantime the war with Turkey broke out and the best had to be made of the means at hand.

On the conclusion of the war in 1878 a supplementary order was issued introducing certain modifications in the terms of the law previously promulgated. Since then some progress has been made in giving effect to its provisions, but these are as yet far from complete, and probably some years may yet elapse before the scheme contemplated is carried out in its entirety.

As will be seen by a reference to Table III, the regimental transport is divided for purposes of movement into three échelons, of which the first remains immediately with the units to which it is attached. The second follows in rear, the light portion of the provision column forming part of it. Further in rear again, following divisions, comes the third or last portion comprising the heavier wagons, amongst them being the four-horsed provision column. Although, therefore, there is in the Russian Army no specially organized divisional transport, the last échelon, though actually regimentally

[1] *Vide* Table III annexed.

Table III.—Present Establishment of Regimental Trains in Russia.[1]

Table III.—Present Establishment of Regimental Trains in Russia.[1]

		Number of horses to each.	Army corps staff.	Staff of an infantry division.	Staff of cavalry division.	Staff of infantry brigade.	Staff of cavalry brigade.	Staff of brigade of rifles.	Staff of a brigade of field or horse artillery.	Artillery *personnel* with cav. div. of the line.	Staff of a brigade of sappers.	Infantry regiment of four battalions.	Dragoon regiment.	Other cavalry regiments.	Battalion of rifles.[1]	Field batteries.	Horse artillery batteries.	Battalions of sappers.
1st Line	Ambulances	4	...	...	...	...	...	...	...	...	...	2	1	1	1	1	1	1
	Apothecary's carts	1	...	...	...	...	...	...	...	...	...	1	1	1	...	...	1[2]	
	Spare gun carriages	4	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	
	Small-arm ammunition wagons	4	...	...	...	...	...	...	...	...	...	4	...	...	2			
	Depth of column in paces	...	...	...	...	...	...	...	...	...	...	7	2	2	3	2	3	1
		...	...	...	...	...	...	...	...	...	...	105	30	30	45	35	50	15
2nd Line	Small-arm ammunition wagons	4	...	...	...	...	...	...	...	...	...	8	2	...	2	...	...	1
	Treasure and office wagons	2	3	1	1	...	...	1	1	...	1	2	1	1	...	...	...	1
	Battery store wagons	4	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	
	Equipment wagons	4	...	...	...	...	...	...	...	...	...	1						
	Clerk's wagon	2	1	2	2													
	Tool wagons	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8
	Medical store wagons	4	...	...	...	...	...	...	...	1[3]	...	1	1	1	1	...	...	1
	Generals coaches	4	3	1	1	1	1	1	1	...	1							
	Field officers' coaches	3	3	3	2	...	...	...	...	...	...	1	1[4]	1[4]	1	1	1	1
	Officers' baggage wagons[5]	2	13	2	2	1	1	1	2	...	2	10	6	6	4	2	2	4
	Light provision wagons	2	1	...	...	...	...	...	...	...	...	16	4	4	4	1	2	4
	Sutlers' carts	3	...	...	...	...	...	...	...	...	...	3	3	3	2	...	...	2
	Depth of column in paces	...	24	9	8	2	2	3	4	1	4	42	18	16	15	7	8	22
		...	360	135	120	30	30	45	60	15	60	630	270	240	225	105	120	330
3rd Line	Provision wagons	4	1	...	...	...	...	...	...	...	...	16	4	4	4	1	1	4
	Hospital equipment wagons	4	...	...	...	...	...	...	...	...	...	1						
	Chapel tent wagons	4	...	1[6]	1[7]													
	Depth of column in paces	...	1	1	1	...	...	...	...	...	...	17	4	4	4	1	1	4
		...	15	15	15	...	...	...	...	...	...	255	60	60	60	15	15	60
Total ...	Vehicles	...	25	10	9	2	2	3	4	1	4	66	24	22	22	10	12	27
	Depth of column in paces	...	375	150	135	30	30	45	60	15	60	990	360	330	330	155	185	405

(1) The Turkestan Brigade of Rifles has pack animals in lieu of carts. These number 84 in peace and 388 in war for the four battalions, including 331 camels. In the train of the Turkestan frontier battalions a large portion of the animals are also employed for pack transport.
(2) This applies only to horse artillery batteries Nos. 1, 3, 5, 7, 9, 11, 13, and from 14 to 21.
(3) Attached to the 1st batteries of division.
(4) The coaches of General Officers in the cavalry of the guard are 4-horsed.
(5) Of the six wagons with every cavalry regiment 1 is for the Commanding Officer, 1 for the regimental staff, and 1 for each squadron.
(6) These properly speaking belong to the 1st regiment in each division.
(7) In the Caucasus 64 per regiment additional for tents.
(8) Twelve paces have been allowed for each vehicle, except spare gun carriages, for which 17 paces have been allowed, with intervals of 3 paces.

[1] Extracted from "The Armed Strength of Russia," compiled in the Intelligence Branch, Quartermaster-General's Department, 1882.

furnished, practically form this together with special formations, viz., the flying artillery park and movable divisional hospitals.

The flying artillery park forms 2 infantry and 3 artillery ammunition columns, and is formed from the artillery. In the Caucasus all the ammunition of mountain batteries and half of the rest is carried by pack transport. The wagons and equipment are kept ready in time of peace.

The movable divisional hospitals answer generally to the sanitary detachments of the German Army. The whole of the material and equipment not of a purely medical nature are in charge of regiments in time of peace. They are horsed on mobilization in the same manner as the other formations, and bearer companies are formed by men from regiments of the division or their reserves. There are also four staff wagons, viz., one per regiment and the transport of divisional and brigade staffs.

The effectives of these several formations are as follows :—

	Officers and officials.	Non-com. officers and men.	Wagons.	Horses.
Flying artillery park	19	841	159	670
Movable hospital	12	314	28	111
Provision train	..	70	70	280
Staff train	..	65	16	43
Staff wagons	..	4	4	16
Total Infantry Division	31	1,294	277	1,120

The train of a cavalry division is composed of a special flying park, providing for the supply of ammunition for carbines and for the two horse batteries, supply train at the rate of four per regiment, and the transport for the divisional and brigade staffs :

	Officers.	Non-com. officers and men.	Wagons.	Horses.
Cavalry park section	3	158	31	117
Provision train	..	18	18	72
Staff train	..	28	9	23
Total Cavalry Division	3	204	62	224

No regular army corps transport is contemplated in the scheme, but the train of the corps administration amounts to 1 officer, 9 officials, 53 men, 25 wagons, 89 horses.

The Army Transport comprises all train not included under the heads of Regimental or Divisional, and includes the Intendance Transport proper, or Supply columns, the Artillery, Engineer, and Hospital Trains, the Horse Depôt, and Headquarters transport.

The whole of these are under the immediate control of the Commander-in-Chief.

The Intendance supply columns are to be formed at depôts maintained in time of peace with a cadre of 1 Officer, 6 non-commissioned officers, and 12 non-combatants taken from the local troops on the spot. The number of

these are fixed by the mobilization scheme, in the proportion of, it is believed, one per division. On the order for mobilization being given, a Colonel is appointed to the command of the whole, and a Field Officer in charge of each column, the *personnel* of which is completed by Officers from the infantry and cavalry and by drafting men as directed by the Minister of War. The material is obtained by purchase, together with the harness required, and the vehicles so obtained are horsed from the animals inscribed according to law. Each column is arranged so as to carry ten days' provisions and three days' forage for an infantry division, attached columns and cavalry, besides ten days' provisions and forage for the whole army transport. But it is not only intended to follow the operating force with these supplies, but also for other purposes on the lines of communications, such as the collection and transferring of supplies from one magazine to another, for the removal of sick and wounded from the hospitals in 1st line and such other services as may be necessary. The establishment of one of these columns is fixed at 5 officers, 3 officials, 52 non-commissioned officers, 747 non-combatants, 587 wagons and 1,290 horses, including 115 as a reserve.

The artillery train comprises :—

(1.) The movable artillery parks, for the purpose of completing the flying park from the stationary park established in rear. These are 84 in number, each having an effective of 2 Officers, 288 men. 55 wagons, 329 horses.

(2.) Movable material and laboratory workshops.

(3.) Artillery transport for bringing up reserves of artillery and ammunition with no fixed establishment.

(4.) Artillery siege park.

The engineer train comprises 5 engineer field parks, of which one for the Caucasus, the engineer siege park and the telegraph park. The hospital train includes 138 temporary hospitals for Russia and 78 for the Caucasus. Of the former only 60 are equipped with transport, being intended exclusively for movement by rail or water, and movable dispensaries. There is no settled number or establishment for the horse depôts. The headquarter completes the columns enumerated as included in the army transport with a total under all heads, 17 in number, of 772 men, 413 wagons, and 1,373 horses.

To complete the list of transport formations, several special columns must be mentioned, which are not comprised in either the divisional or army transport. These are the rifle brigade park section, sapper battalion pontoon train, and railway battalion.

Supply.—In time of peace bread or biscuit or else flour or meal as a substitute for it is issued in kind, an allowance in money being given for meat, estimated for about 8 ozs., and varying with the local prices, with a fixed allowance for vegetables, groceries, &c.

In time of war all issues are necessarily made direct, and the allowance in 1877–78 was 14·3 ozs. meat, 42·9 ozs. bread, black but good, preserved vegetables and tea, with an issue of brandy in the winter.

The arrangement for the forage failed owing to immense quantities collected at Odessa, Kichinev, and other depôts having rotted, and recourse was had to Warneck's forage biscuits, of which 20,000,000 were used. The weight of a ration of these was about 4 lbs., which lessened enormously the difficulty of transport, a supply for several days being easily carried slung on the saddle. The component parts of these were rice flour, oat flour, crushed peas, and linseed, and the horses are reported to have kept their condition on this food. The troops carry with them 3 days' rations without meat, and mounted branches 2 days' forage besides the train carrying 4 days.

In the light provision wagon of the regimental transport are carried 1 day's biscuit, 3 of meal, bacon, salt, and brandy, 4 days' grain ration and 2 of hay.

The four-horsed wagons with divisional transport carry 4 days' rations of provisions and grain with 2 days' hay.

As a reserve the movable columns carry 10 days' provisions and 3 days' forage, and 7 days' additional forage for the horses of the army transport formations.

Strict orders are issued forbidding the consumption, without direct orders, of the rations carried by the men, and the current supply is ordered to be obtained either from fixed magazines or from the country itself, recourse being had to the supply columns in reserve only when both these sources fail.

Besides these movable magazines stationary ones are established at the base, which are permanently maintained in time of peace, in the vicinity of the frontiers, at points where the concentration of an army might probably be effected. These are of two kinds, one class of which is established with a view to ensuring an adequate supply in case of any interruption in the ordinary supply. The normal quantity of provisions and stores maintained in these consequently varies according to the circumstances of the case, the magazines in Turkestan, where communication is difficult and the inhabitants hostile, containing as much as from 2 to 6 months' supply. The other class are exclusively established with a view to a concentration of troops in the vicinity, and their capabilities are regulated accordingly. In time of peace these are not drawn upon in the ordinary course at all, but the Intendant-General provides for the consumption at regular intervals of such provisions as would deteriorate by long keeping, and the magazines are subsequently refilled by purchase.

As an army moves from its base provision is made for the establishment of intermediary magazines, the number of these and their situation being determined by the special circumstances of the case, as also the quantities to be collected in them. These are supplied entirely by requisition whenever the country will allow of this course being adopted, and when necessary the supply columns of the army transport assist in filling and transferring these, sections of them being kept at various points on the lines of communications for this and other purposes.

Étappen magazines are established on these at the principal étappen stations for the supply of troops in transit and the immediate issues to those permanently employed at these stations.

Issuing depôts in the front complete the system of magazines, being established in as close vicinity as circumstances will allow to the 1st line, the movements of which they follow, providing for the immediate current supply of the troops.

Comments.—The details of the several services and methods in Russia are necessarily meagre from the fact that these are almost entirely in a state of transition, and that the general system for the administration and supply of an army in the field is not laid down with the same detail and exactitude as is the case with other Continental armies. It is only of late years indeed that any attempt has been made to reorganize and regulate these services in such a manner as to meet the requirements of a large army in the field, and much time must elapse before satisfactory results can be expected. It was only as far back as 1874 that the law for the reorganization of the army, consequent upon the introduction of universal compulsory service four years earlier, was promulgated. Two years later the mobilization was commenced preparatory to the war with Turkey, which during the following year strained all her resources and made any progress in regular organization impossible. Since the close of this much has been done to carry out the administrative reforms and create an adequate system of transport for the enormous forces called into creation by the new law. But much remains still to be done, the restrictions upon expenditure, the maladministration and other causes, necessarily making any progress a

matter of great difficulty. The first steps have, however, been taken, though at present the Russian Army must be placed last as regards the provision made for maintaining it in the field in a condition to execute the extended and rapid movements called for by the system of war now in vogue. If, however, the Russian soldier has suffered, and may not improbably suffer again, from the want of an adequate and efficient system of supply, it must always be remembered that he has an enormous advantage over the ordinary soldier of other nations in his extraordinary powers of endurance. The black bread which he carries with him for occasions of emergency is sufficient to keep him in good heart when others would starve on it.

Italy.

Intendance.—The foregoing term has been adopted as the title best calculated to embrace in all armies that service which is in our own known as the Commissariat. In dealing with Italy, however, some confusion might arise, which may be best avoided by a brief explanation. In the Italian Army the same title is adopted as in our own, the so-called Commissariat Directions being solely responsible to the Ministry for the direction and execution of the administrative services in time of peace. On mobilization, however, this is no longer the case, for a special control is then created by the appointment of a General Officer as Intendant-General (Intendente-Generale) who supervises the whole of the administrative and special services in rear of the 1st line, being represented with each army, should there be more than one in the field, by an Army-Intendent.

Reverting now to the service in ordinary times, the War Ministry has under it four "General Directions," one of which regulates the administrative services, including provisions, clothing, barracks, and transport. Operating under it are "Commissariat Directions" in each of the twenty military districts into which the country is divided, which provide for the direction of the service, the execution of which is provided for by Officers of the same department. These have actual military rank, which is indicated in the titles of the respective grades, the establishment of which is as follows :—

Commissary	Colonels	8
,,	Lieutenant-Colonels	12
,,	Majors	24
,,	Captains	99
,,	Lieutenants	98
,,	Sub-Lieutenants	50
	Total	291

Vacancies in the corps are filled by promotions, by civilians, or by Officers of the Army, the candidate in the latter case having to undergo an examination and serve a certain period on probation.

Upon a force taking the field, so-called Commissariat Directions are formed for each unit under a General Commissariat Direction at headquarters, which is itself under the General Intendance Direction. The Officer at the head of the Commissariat General Direction provides for the collection, storing, and distribution of supplies in the establishments of the 2nd line and superintends the technical part of the arrangements. He has under him the Officers of the commissariat, who have the general direction and execution of the supply service, the accountant Officers, who see to the technical matters, the returns and accounts, and the finance officials, who are entrusted with the custody of and disbursements from the military chest and the keeping of the accounts connected with it. The Officer in charge of an Army Commissariat Direction is a Commissariat Colonel, and he is in like manner under the control

and supervision of the Army Intendance Direction, under whose authority he provides for the commissariat services in 2nd line within the entire zone occupied by the army to which he is attached, and is further responsible for the completion of the establishments in 1st line, by seeing that sufficient supplies are pushed forward to replace what is consumed from day to day. He also regulates the supply of the military treasury chests and distributes the clothing and equipment parks under instructions from the Army Intendants. He has under him for the execution of the several services 56 Officers and officials, 780 of other ranks, 210 civilians, 214 vehicles, and 443 horses, including 3 sections of the field bakery, 1 reserve army supply park, 1 company mobile militia, and 1 clothing and equipment park.

The Army Corps Commissariat Directions constitute the centre of the supply service of divisions. The Officer in charge is responsible for the transport of bread from the bakeries to the places of distribution, and he keeps the magazines of the 1st line constantly complete with dry provisions and forage. Besides his general administrative direction, he is responsible for the actual distribution to non-divisional troops of the army corps. The Director is a Commissary Lieutenant-Colonel, having under him for executive purposes 8 Officers, 29 clerks, orderlies, servants, &c., and a detachment of transport. He is directly under the General Officer commanding the army corps, though responsible also to the Army Commissariat Director.

The Commissariat Director of a division is in like manner under his military commander, besides being responsible to the army corps Director for the supply of the troops in 1st line. Should his division be detached, he will act independently, providing for its supply from local sources. This Officer is a Commissary Major, and has under him 7 Officers and 19 men, with a detachment of transport.

The administrative services on the lines of communication are arranged for in a similar way by the appointment at the more important stations of Etappen Commissariat Directions, having the same scope and general duties in connection with supply.

To return to the Intendance proper, as it exists in the Italian Army, it forms, as it were, a special service for the higher direction and general supervision of all departments, establishments, and services behind the fighting line, answering thus in a great measure to what is in other European armies known as the service of the line of communications, though its scope is more extensive in some directions.

To each army is attached an Army Intendant, a Major-General, who acts under the general directions of the Intendant-General of the Forces, being assisted by a staff of 23 Officers, who overlook the direction of the several services under him. These are the Commissariat, Veterinary Department, with horse depôts, the artillery and engineer parks.

The Direction of the Intendance-General of the Forces, attached to the headquarters of the Commander-in-Chief, has a still wider scope, and a Lieutenant-General is selected for the responsible post of Intendant-General.

He has a general supervision and control over all the administrative and other services and establishments in rear of the 1st line, which are exercised through Officers of the general staff, and of the several services attached to his staff, at the head of which is a Chief of the Staff, being a Major-General or a Colonel. The number of these in all is 31 Officers, 184 men, 14 civilians, 11 carriages, and 73 horses, the latter being provided by a section of the artillery train. Amongst the Officers are commissaries, accountants, and the commandant of gendarmes, whilst civilian directors and employés are borne for the purpose of superintending the telegraph and post office services. The several departments and special formations falling under the control of the Intendance-General are as follows:—

1. The Sanitary Direction, under a Surgeon-Colonel or Major.

2. Commissariat Supply Section, under a Commissary Lieutenant-Colonel or Major.
3. Telegraphs, under civilian director.
4. Postal service, ditto.
5. Transport Direction, under a Major-General or a Colonel as Director-General.
6. Etappen service.
7. Veterinary department, under a Veterinary Captain.
8. Artillery material parks, under a Lieutenant-Colonel or Major of Artillery.
9. Engineer park, under a Lieutenant-Colonel or Major of Engineers.
10. Royal Carbineers, or mounted police.

The Intendant-General is in constant relations with the Commander-in-Chief of the army, whose orders he receives as well as information of such movements and occurrences as may affect the departments and services over which he presides. He submits to the Commander-in-Chief all service reports and propositions, and seeks from him general directions as to the formation and placing of the army establishments in 2nd line. Acting on his own authority, he decides all administrative questions referred to him by the Commander-in-Chief or Army Intendants, being guided in so doing by the laws and rules of the Service. He also fixes the lines of communication and the services and establishments on them, acting through the executive Officers attached to him. He is further responsible for keeping the Minister informed of the requirements in men, material, and stores from the base, in order to enable these to be prepared and forwarded. Acting, therefore, personally, he receives from the Commander-in-Chief such information and instructions as will enable him through the heads of departments attached to his staff, and the Army Intendants, to direct generally the whole of the administrative services with the force, while its requirements are known through them and the Chief of the Headquarters Staff, and communicated direct to the authorities at the base. Further than this general direction it would be impossible to go, and no attempt to do so is contemplated. The Army Intendants are responsible to him for a closer direction in their respective armies, while they again look to the heads of the several administrative departments in army corps for the execution in detail of the necessary services as directed.

Transport.—There is in the Italian Army no independent train or transport corps, but the necessary service is performed in part by a regimental organization, and partly by an artillery transport formation, an equivalent formation in the engineers providing for the services of that corps, while a supplementary civilian train is formed to assist the permanent formations upon mobilization.

In time of peace each regiment has with it the regulated number of carts fixed for the reduced establishment, the balance of the material being kept stored at certain points. At present the storing of such material depends very much upon the accommodation afforded by existing magazines, but it is intended that the North Italian districts shall take charge of that required to complete those regiments stationed in them to a war footing, and that those districts on the right of the Po, north of the Appenines, shall further provide for that of the cavalry, infantry, and rifle battalions which would be brought up from South Italy unprovided. The heavy trains for the artillery, engineers, supply, and sanitary services are stored partly at the headquarters of artillery and engineer regiments, and partly in the district magazines.

In time of war the whole of the transport service is regulated and directed by a general transport direction, at the head of which is placed a Major-General or Colonel specially selected, who is under the control of the Intendant-General, but acts independently in directing the transport services by rail, road, and water. For this purpose he has attached to him eighteen Officers, including representatives of the general staff, artillery, engineers,

medical department, commissariat, and other arms. Superior Officers are also appointed to act as army transport directors.

To commence with the lesser units, the regimental transport has several different establishments as follows :—

Infantry :—1. Complete Mobilization.—Each regiment has 18 two-horsed two-wheeled carts with 36 draft horses. Of these 6 carts and 12 horses are detached for services with army corps reserve supply magazines, besides 1 two-horsed cart to brigade staff from the right regiment of the brigade. Of the remaining twelve 1 baggage cart, 1 provision cart, and 1 sanitary cart are attached to the regimental staff, and a like proportion to each battalion.

2. Partial Mobilization.—The same as above, but without employing the carts required for the supply magazines.

3. As above, but further reduced by 16 horses.

4. Peace Establishment.—When each regiment has only 13 one-horsed carts—the remaining vehicles being kept at the chief mobilization district.

Bersaglieri or Rifles :—1st Formation.—23 two-horsed carts and 46 draught horses, of which 8 and 16 respectively are detached to reserve supply magazine.

2nd Formation.—20 horses and 8 carts less.

3rd Formation.—Only 16 horses.

Peace Establishment.—1 one-horsed cart per battalion.

Alpine Companies :—At all times 1 two-wheeled cart and 12 horses, of which 11 are utilized in the district in peace-time, and as pack animals on mobilization.

Cavalry :—1st Formation.—17 two-wheeled carts, 6 four-wheeled wagons, and 6 field forges, with 70 draught horses utilized as follows :—

Regimental Staff.—3 two-wheeled carts. Each squadron :—2 two-wheeled carts, 1 four-wheeled wagon, 1 field forge. The right regiment of a cavalry brigade detaches 1 two-wheeled cart for the service of the brigade staff.

2nd Formation.—Only 28 horses.

3rd or Peace Formation.—1 two-wheeled cart for staff, and 2 per squadron with 13 horses.

Artillery :—Permanent formation 4 two-wheeled battery carts.

This forms the transport service of the 1st line, and provides for the service of brigade headquarters and reserve supply magazines by means of the carts drafted from the infantry and rifle regiments.

The artillery train service provides 30 companies, and the engineer train service 6 companies, formed into brigades under a Field Officer, which in peace-time usually remain with their headquarters in the garrison town of their corresponding regiments of artillery or engineers. From these transport columns are detached, as required, for duty elsewhere. The Officers belonging to these companies have an independent establishment and separate promotion list, but the highest rank to which they can attain is that of Major. The non-commissioned officers and men are drafted from the respective corps, the uniform of which they wear. The material required to form the heavier columns on mobilization are collected in large magazines at Verona, Mantua, Bologna, and Piacenza, and are under the orders of the commanders of the several military districts.

On mobilization the train companies of the two engineer regiments are divided into sections and provide for the transport of the bridge equipages, the engineer, army, and army corps parks, the telegraph columns, and for the pioneer and railway companies. The war strength of each of these train companies is as follows :—

6 Officers, including 2 veterinary surgeons, 11 non-commissioned officers, 31 corporals, 24 lance-corporals, 6 trumpeters, 16 smiths and farriers, 9 Officers' servants, 366 men, 48 saddle horses, and 520 draught horses.

The artillery train companies, three of which, forming a brigade, belong to

each of the ten artillery regiments, are likewise divided into sections and provide for the transport service of general, army and army corps, headquarters, general and army Intendance directions, commissariat directions, supply, bakery and sanitary columns, and artillery parks. When insufficient to meet all the requirements of these, the deficiency is supplied by squadrons of civilian train, which is the only transport employed by the several subordinate inspections, besides entering largely into the composition of the commissariat columns for employment with the reserve supply, equipment, and clothing parks.

The brigade of train of each artillery regiment provides for the transport service of the army corps in which its batteries are incorporated by means of three companies, composed respectively of three, two, and four sections, employed as follows :—

The first company provides for the staff, commissariat directions, sanitary, and supply sections, and the artillery parks of the two divisions. The second company provides for the army corps artillery park. The third company for army corps staff, artillery, and engineer commands, commissariat direction, bakery columns, and for the sanitary and supply sections of the army corps.

Each brigade further supplies a detachment for services in connection with army and general headquarters as follows :—

The 1st regiment furnishes the headquarter staff and general Intendance direction.

2nd, 3rd, and 4th regiment, army staffs.

5th to 10th regiments, two detachments for each of the three army Intendance directions and their establishments.

The war strength of a company of the artillery train is 9 Officers, including 2 veterinary surgeons, 11 non-commissioned officers, 35 corporals, 28 lance-corporals, 7 trumpeters, 16 smiths and farriers, 10 Officers' servants, 392 men, 52 saddle horses, and 576 draught horses.

Subsidiary to the regular formations described above is the civilian or hired train already adverted to. This service is carefully provided for in the Italian organization, and is arranged in time of peace by the commissariat directors of regions, so as to be available for utilization during the period of mobilization and concentration, as well as subsequently on the lines of communication. The orders for mobilization direct the formation of squadrons of a fixed establishment in the proportion required, and the commissariat directors are responsible for giving effect to these and forming the squadrons without any delay. To enable them to ensure this they inscribe in time of peace suitable carts and horses, the number being ruled by the fixed establishment of the squadrons allotted to their particular district. The vehicles are the ordinary country pattern of two-wheeled cart. On mobilization being ordered these, as inscribed previously, are called up, and if passed as in thorough repair and the horses as sound, both cart and team are bought at a pre-arranged price. Drivers and superintendents, the latter in the proportion of one to every twenty carts, are also engaged at a certain rate for the duration of the war, being dealt with while so employed under a special code.

Besides these first formations, other squadrons are subsequently formed under the orders of the War Minister to assist during the operations. Provision is also made for the formation of others in an enemy's country if judged expedient, the necessary orders being given by army corps commanders if in the 1st line, and if otherwise by the head administrative authority. This is directed to be effected if possible on the same lines as the squadrons raised in Italy ; but, if this cannot be done, resort may be had to requisition for satisfying the requirements of the operating forces.

Another means of transport remains to be mentioned, in the employment of which Italy stands alone, though its merits have not been disregarded by

other Powers. This is machine transport by means of traction engines which have been regularly introduced, and from which very useful results are counted upon. The reason for the introduction of these is the difficulty experienced by Italy in obtaining a sufficient quantity of horses to provide for all the requirements on mobilization. In 1866 between the 25th March and the 4th of May only 24,901 horses could be obtained from all sources, of which nearly 10,000 were imported, whereas the total numbers required, including saddle, draught, and bât animals over and above the normal establishment, is no less than 60,000. It has been estimated that of the entire number about 10,000 are required for the various services between the fixed depôts in rear and the headquarters of the armies and army corps, and it is considered that by the employment of machine transport in their place this number of horses might be dispensed with. So far as trials in peace-time go the results have been satisfactory enough, and they can be no doubt counted upon to perform the work they are intended for between predetermined depôts and establishments, provided the roads between them are suitable and adequately furnished with watering and coaling stations, which are of course indispensable. The rate attained by the Italian engines is from 3 to 3½ miles an hour, and with unobstructed roads 50 to 60 miles might be counted on in the day.

The railway transport is arranged with the same care and detail as the other services, and the lines are during mobilization and concentration under the general direction of transport attached to the War Ministry. When these preliminary processes are completed the direction is moved forward, and under the Intendant-General takes over the control of the sections of the several lines between the front and certain stations, in rear of which the lines revert to the ordinary administration. The direction and control of the service of these military sections is provided for by the appointment of line commissioners and station commandants as required by the circumstances.

Supply.—There are in time of peace three large central magazines for stores and equipment at Turin, Florence, and Naples, and thirty-seven provision depôts in the larger garrisons for the manufacture and supply of bread and biscuit. On the order being given for complete or partial mobilization, the Intendance proceeds to establish a system of provision parks, supply columns, field bakeries, and live cattle columns on the required scale. These, on complete mobilization, are composed and classified as follows :—

1st Line of Supply Services :—

1. *Army Corps Supply Column.*—Subdivided into three sections, viz., one per division and one for the non-divisional troops of the army corps. These are composed of a *personnel* of supply officials and men with a detachment of artillery train. Each section carries one ration of meat, fresh or preserved, or cheese, salt, and oats, and to each is attached a live stock column representing two days' supply.

2. *Field Bakery Sections* at the rate of one per army corps. A section is composed of 14 ovens, of which 7 are kept at the central depôt, and the necessary transport connected with the 7 which take the field, viz., 16 carts, are provided from civilian transport. The *personnel* of a section numbers 8 Officers and 169 men.

3. *Bread Train Supply Columns.*—In the proportion of one per army corps, furnished by a section of the artillery train, numbering 3 Officers, 205 men, with 60 wagons, and 258 horses, carrying one day's bread for the entire corps. These are subdivided and distributed as desirable in connection with the bakery sections.

4. *Army Corps Reserve Supply Column.*—The *personnel* and vehicles for this are drafted from infantry and rifle regiments, as has been already noted under Transport. It is composed of 56 battalion two-horse carts, carrying four days' rations of salt, coffee, and sugar, two days' biscuit, and one day's

oats for the troops of the army corps, estimated at 30,000 men and 5,000 horses.

Cavalry division reserve columns are formed in like manner, but carry instead one day's biscuit, preserved meat, salt, sugar, coffee, and oats.

In the field the whole of these columns in the 1st line are under the direct orders of the Generals commanding army corps. The provisions for completing the several columns are obtained, whenever this method is possible, by requisition or by purchase.

The supply formations and establishment in 2nd line are divided into the army advanced establishments and the central and intermediate depôts, and are under the charge and direction of the Intendant directors. The indicated method of keeping them completed with the fixed establishment of provisions and stores is by contract.

The advanced army establishments are subdivided as follows :—

1. *Advanced Army Magazines* of ordinary supplies established according to circumstances, and with regulated quantity of supplies.

2. *Army Reserve Supply Park*, having a *personnel* of 1 Officer, 205 men, 150 two-wheeled country carts, with 300 horses, and 150 drivers of the supplementary civilian train. A company of the mobile militia forms a guard to the column. It carries 3 days' biscuit and salt, 1 day's preserved meat or cheese, 2 of coffee or sugar, and sometimes wine, besides 1 day's oats for the entire army to which it is attached.

3. *Cattle Park.*—In connection with the central depôts are general store depôts, with cattle depôt and bakery, containing 6 days' biscuit, 4 of meat, 5 of coffee, and 9 days' oats for the whole of the forces.

Besides what is carried and stored respectively in these several columns and magazines, each soldier carries on his person a reserve of two days' biscuit and preserved meat, and the battalion carts carry with their respective corps one day's ordinary provisions and forage.

The total supplies provided, therefore, for the entire force, and distributed as already described, are as follows :—

Provisions :	13	days' biscuit.
	13	„ coffee, sugar, or wine.
	12	„ salt.
	11	„ meat, fresh, preserved, or salt, or cheese.
	2	„ meal or rice.
	2	„ bread.
Forage :	12	days' oats.
	1	„ hay.

It is estimated that generally speaking four days' more will be available by means of requisition or purchase in 1st line. The number of formations required in addition to the regimental transport for the carriage of the movable portion of these is :—

30 supply sections.
10 field bakery sections.
10 bread train columns.
10 army corps reserve supply parks.
3 army reserve supply parks.

The mobile militia, which forms the first reserve of the regular Army, has supply establishments of the 1st line, the same as the latter and similar army corps establishments, the services being organized by means of supplementary civilian train squadrons.

The second reserve or territorial militia has no organized train formations.

The first measure, upon mobilization, is to complete the issue of the two days' reserve ration, which is carried also in peace-time by those serving.

Before setting out for the points of concentration, a four days' supply of flour or rice, bacon, salt, coffee, and sugar is issued for consumption exclusively on arrival at the place of concentration, and is not to be touched during the journey. Bread is also issued for the duration of the railway journey, other rations being issued at regular supplying stations on the way, at which halts are made for the purpose.

If marching by road, the troops are supplied in the usual manner, meat being obtained by purchase, and bread from military bakeries or by requisition on repayment, and forage also by the latter method.

Troops, therefore, should arrive fully rationed, excepting bread and meat, for four days besides the reserve rations. On the day of arrival they receive from the special supply service, organized with supplementary train squadrons in the zone of concentration, bread and meat for the day following. This issue only is made for four successive days, after which full rations of all kinds are issued daily.

Forage is provided for by the mounted branches up to the day of arrival inclusive, after which a daily issue is made by the Supply service. This special service in the zone of concentration ceases altogether when this approaches completion, and then is replaced by the regular service.

After taking the field the troops draw their regular daily requirements from the "Supply sections," which are completed by contract, purchase, or requisition. In the case of these sources failing they have to fall back upon the army corps reserve parks and ultimately upon the army reserve parks. It is only in the last extremity that resort is had to the reserve rations carried by the men.

The Italian regulations only prescribe requisitions as an exceptional measure to be adopted ordinarily only by advanced guards and detached parties. So long as the communications remain intact the main body would be fed from the rear. In exceptional circumstances, such as when, owing to the troops being actually engaged. the supply columns are prevented from getting up, requisition is to be resorted to. Directions are given also in the regulations as to the course to be adopted for supplying the troops during a retreat so that this important matter may not be left to chance when the occasion arises. In reference to this, particular stress is laid upon the difficulty which always arises in supplying the rear-guard, and though this is a matter regarding which no fixed rules can possibly be laid down, attention is called to the immense importance of taking every possible care to provide for issues being made as regularly as possible.

Comments.—As will have been seen from the description given of them, the arrangements in Italy for the administration, transport, and supply of armies in the field have been worked out with great care and detail.

The adoption of the system in vogue bears sufficient evidence of being based upon the generally accepted model of Germany, but the special circumstances of Italy have not been left out of sight, while in some respects innovations have been adopted in advance of other armies. In time of war the administrative services are subordinated to combatant Officers of high rank, thus relieving the Commander-in-Chief and Generals commanding armies from all but the secondary responsibility for them. This method meets the objection which has been urged against subordinating the administrative services to the General commanding, and rendering him immediately responsible for their direction, which has been alleged to throw too much upon him, at a time when his attention should be fully occupied with the disposition of his own troops and the movements of the enemy. This objection is generally met by the Chief of the Staff being deputed to act as his organ, and concerting with the chiefs of departments at headquarters the necessary arrangements to be made by the administrative services and their proper direction. But in this case again an objection remains, in the fact that the Chief of the Staff also has

enough to occupy him fully in the direction and control of the combatant troops. The dispositions, therefore, introduced into the Italian organization by which a selected Officer of experience and standing is specially appointed on mobilization to represent the Commander-in-Chief in all these matters, and who is provided with a Chief of the Staff and adequate Staff under him to undertake the direction and control of the whole of the administrative services, would appear to be most desirable in Continental armies, which are now organized on a system by which hundreds of thousands of men can be placed in the field, the disposition and direction of whom demand the undivided time and attention both of the Commander-in-Chief and his Chief of the Staff. The transport arrangements would appear to be of a somewhat complicated nature, and the arrangement by which one column is formed of carts and *personnel* drafted from regiments, another of regular artillery train, and a third of civilian transport can hardly be expected to give satisfactory results. There is a great advantage for mobility in having almost the entire material composed of two-wheeled carts. The introduction of traction engines, for the purpose of supplying in some degree the deficiency of horses, is a novelty, but may, nevertheless, prove of extreme use to other armies besides that of Italy, if employed for certain specified purposes on the lines of communications. The Continent is so intersected with railways that in the later wars which have taken place there has generally been little difficulty in arranging for depôts to be so selected as to be in communication by rail, both with the base and the front. During concentration, however, these are fully occupied in the conveyance of troops, and at other times cases may occur where road-engine transport may be feasible when this is not, and its employment may save the laying down of branch lines of rail. In the arrangements for supply, the method of providing for the troops during concentration is particularly noticeable. The journey by rail is provided for in such a manner as to ensure the men being regularly fed on the way, and having in possession on arrival several days of groceries, &c., leaving only bread and meat to be issued. These, and further subsequent issues, are arranged for by means of a special service having no part in the field organization for supply, and allows of the several columns and establishments being organized without interruption or delay. In order to accustom the soldier to carrying and taking care of his reserve rations, these are always in his possession in time of peace, and become by second nature a portion of his daily equipment. The prescription against employing requisition, except for small parties and in case of emergency, is not in accordance with the generally accepted method which recommends itself in the present day, and it is difficult to account for it. The attention directed to the supply of troops during a retreat is too often omitted even from the best organized systems, but its importance can hardly be over-estimated.

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REORGANIZATION OF THE ROUMANIAN ARMY.

From the Russian "Invalide" of 29th May, 1882.

Translated by Captain J. C. Dalton, R.A.

The organization of the military forces of Roumania has, during the last few years, been the subject of constant modifications, chiefly directed towards increasing the numerical strength of the Army.

On the eve of the last Russo-Turkish War, the Roumanian field army consisted of 8 infantry regiments, 4 rifle battalions, 2 regiments of cavalry, 2 regiments of artillery, and a battalion of field engineers.

The territorial army was composed of 8 regiments of cavalry and 8 batteries of artillery.

At the end of 1876, the numbers of the territorial army were augmented by 16 infantry regiments; followed some months after, on 15th March, 1877, by 2 new artillery regiments; added to the strength of the standing (regular) Army.

In April and May, 1880, the territorial army was again increased, the infantry from this date consisting of 30 regiments, and the cavalry of 11 regiments. In that same year, on November 12, the second battalion of field engineers was formed.

The year 1881 brought the first real increase to the Roumanian Army; the reserve of the territorial army was formed of 30 infantry regiments, and the artillery increased to 14 batteries. The artillery of the standing army was, in the same way, increased from 4 to 5 regiments.

Thus, at the present time, the Roumanian Army, if brought up to a war strength, should have 117,000 men and 264 guns.

The Roumanian War Ministry apparently acknowledges it as indispensable

to make a still larger increase to the military forces of the young kingdom, the numbers of which during the last five years have been augmented by more than 50,000 men, and at the same time more thoroughly to organize the new army.

The French military paper "Revue Militaire de l'Étranger" has printed a projected scheme "On the Organization of District Commands," worked out by the Roumanian War Office, and which will shortly have to come before the Roumanian Chambers to be debated on.

This scheme is directed towards the attainment of the two above-named objects, viz., the increase of the Army and the more regular organization of the forces and of their military administration.

In this scheme is laid down the general numbers of the Army dependent on the size of the annual contingent.

The number of young men who are liable annually to military service amounts at least to 25,000; consequently, with 8 years' term of service, there will be at the disposal of the War Minister, leaving out losses from exemptions, &c., 200,000 men.

Deducting 50,000 men for special destinations, to which we shall allude later, and for the losses by exemptions, &c., the War Minister estimates it as possible to have the field army up to the strength of 150,000 men.

The proportions of the different arms will be as follows:—

32 Regiments of infantry, in 3 battalions each.
8 Rifle battalions.
20 Regiments of cavalry, in 4 squadrons each.
8 Regiments of artillery, with 6 to 9 batteries per regiment.
4 Battalions of field engineers, and a definite number of auxiliary services.

With each of the above tactical units must be associated reserve cadres of a battalion, of a battery, squadron, and company.

The field army is subdivided into 4 army corps, which are given a tactical as well as a territorial organization.

All the territory of Roumania is divided into 4 army corps districts, and the military territorial division of the country will be applied also to the composed parts of the Army, so that in each corps district there will be 2 division, 4 brigade, 8 regimental, 24 battalion, and 96 company districts.

Dobrudscha will comprise a separate division district, subordinate to the Commander of the 3rd Army Corps.

The various tactical units of the field army are disposed in their corresponding territorial districts from whence they receive their recruits, and where their reserves are stationed.

The organization of the Army Departments will agree with the military territorial subdivisions of the country.

Each army corps will have two infantry divisions (8 regiments and 2 rifle battalions), a division of cavalry (4 regiments), a brigade of artillery (2 regiments), a battalion of engineers, a transport squadron, and troops and departments for the auxiliary services.

The corps are organized independent of each other and may operate separately.

In consequence of the topographical character of the country, the Roumanian Army needs as great a force of cavalry as possible, and beyond the normal tactical proportion to the troops of the other arms, and, therefore, although in the composition of each army corps there are 4 cavalry regiments, the War Ministry deems it advisable to form a separate cavalry division.

At last it foresees the necessity, in the time of military operations, to strengthen the fighting army by new active battalions, to form which the remaining reservists of each regimental district are required, so that each corps district would be able to furnish 8 new infantry battalions.

The fundamental problem of military organization of the present day is to

be able to maintain, in time of peace, an insignificant army, which, on mobilization, should swallow up the entire store of men who are instructed in military matters, and this the new scheme solves in the spirit of the former organization of the Roumanian Army, viz., preserving obligatory military service by reliefs. From the general composition of the Army it takes out rifle battalions, a separate cavalry division, all the artillery, engineers, and parts of the auxiliary services, and gives for them weak establishments with leave to serve permanently. All these military parts must have their particular district for completion, which is determined, dependent on the strength of the population, so that permanent army service may be equally distributed through the whole country.

On the commencement of mobilization, all reservists liable to serve in the field army, 25,000 men, are told off in the district which is named. *Vice versâ* all infantry and remaining cavalry bear the service by reliefs. Out of 3 battalions of each regiment, there are annually called up under the colours only 1 battalion on a war footing. The remaining ones have really only Officers and a fixed establishment of non-commissioned officers. The annual contingent of recruits distributes to the whole regiment, and the cadres of battalions not called up for service are annually occupied in the course of three months instructing recruits.

In each of the 16 cavalry regiments on actual service, there is 1 squadron which is charged with the instruction of all the recruits of the regiment.

A comparison of the projected reorganization of the Roumanian Army with the present state shows, before everything, that the present subdivision of the Army for the standing and territorial armies is abolished.

The armed strength of Roumania, when reorganized according to the scheme, will consist of the field army and militia (which is equal in numbers to the field army and perfectly analogous to it in organization). The militia will be formed on the announcement of mobilization, and will take the place of the field army on its being moved to the theatre of operations.

The scheme gives the organization of the military forces a complete territorial character, which hitherto it did not possess, although the territory of Roumania is divided into 5 division districts, but these districts do not correspond to the tactical subdivisions of the Army in peace-time, and have not got any worked out organization.

Finally the composition of the various arms has undergone an important change, as will be seen from the following tables :—

PRESENT COMPOSITION.

(i.) *Standing Army.*

Infantry.....	8 regiments of 2 battalions.
Rifles	4 battalions.
Cavalry	2 regiments of 4 squadrons.
Artillery	5 regiments (30 batteries in all).
Field engineers....	2 battalions.

(ii.) *Territorial Army.*

Infantry.....	30 regular and 30 reserve regiments (2 battalions).
Cavalry	11 regiments of 4 squadrons.
Artillery	14 batteries.

PROJECTED COMPOSITION.

Infantry.....	32 regiments of 2 battalions.
Rifles	8 battalions.
Cavalry	20 regiments of 4 squadrons.
Artillery	8 regiments (56 batteries in all).
Field engineers....	4 battalions.

NOTICES OF BOOKS.

The Soldier's Pocket-Book for Field Service. By Lieut.-General Sir Garnet J. Wolseley, G.C.B., G.C.M.G., Adjutant-General to the Forces. Fourth edition, revised and enlarged. With Illustrations. London: Macmillan and Co., 1882. Pp. 531. Size $5\frac{1}{4}'' \times 4\frac{3}{8}'' \times 1\frac{3}{8}''$. Weight under 1 lb. Price 5*s.*

THE preface to this edition is as follows:—

"When the first edition was published there were but very few modern military works in our language, and the military education of the Army was at a very low level. The fourth edition of 'The Soldier's Pocket-Book' appears under a very altered aspect of affairs. We possess a considerable military literature, and of military text-books there are many. I have endeavoured to make this edition equal to the standard of military education of to-day. I do not profess to write upon the science of war; those who would make that interesting topic their study can do so to the best advantage in the pages of Sir Edward Hamley's most admirable work. 'The Soldier's Pocket-Book' deals with all subjects connected with the actual practice of warfare, especially under those phases in which it is most commonly presented to us in our wide-extending Empire. I regret very much that my departure for Egypt has prevented my seeing the proof-sheets through the press, and adding a few articles on new subjects of interest. I feel, however, every confidence that this fourth edition, despite its shortcomings, will be of great practical value to those for whose use it is written."

The additional 132 pages in this edition have, by some good management on the part of the publishers, hardly increased the weight of the "Pocket-Book." They contain fresh information regarding administration, organization, transport service, and nearly every conceivable subject connected with the profession; and also a number of valuable tables of details of equipment, &c. Information respecting the Indian Army is one of the features of the new edition. The views of the distinguished author himself on tactics and troop leading find full and open expression here, in some cases for the first time in the "Pocket-Book," and will doubtless receive close consideration from those who are likely to take part in British military operations of the future.

Eine Uebung in der Taktischen Thematik. Von Ernst Schmedes, k. k. Oberstlieutenant in 47. Infanterie Regiment. Wien, 1881. Verlag der Oesterr. Militärischen Leitschrift. Pp. 214. Size $9\frac{3}{4}'' \times 6\frac{1}{4}'' \times \frac{1}{2}''$. Weight 12 ozs. Price 5*s.*

REMEMBERING the useless expenditure of space and printer's ink attending the placing before the military public, in No. CVI of this Journal, "A Cavalry Tour of Instruction" (Die Kavallerie-Uebungs-Reise in Mähren), by Colonel v. Merta, it is perhaps foolish to bring forward this work of a similar character and intended for the use of all arms of the Service. For those who being engaged in teaching practical work are aware of the difficulties in their path, this volume, the result of experience gained as teacher in tactics and leader of these tours at the Austrian Military Academy, will be of great value. Some day, perhaps, others besides professors and instructors may believe there is really something to be learned from these tours, and to them this work will be of great assistance. But there will be plenty of time before that period arrives to put portions of the book at all events into an English dress.

Les Nouvelles Défenses de la France. La Frontière 1870–82. Par Eugène Tónct. Paris: Librairie Germor Baillière et Cie. 1882. Pp. 452. Size $8'' \times 6\frac{1}{2}'' \times 1\frac{1}{2}''$. Weight under 2 lbs. Price 8 francs.

THE object of this work is, in the words of the author, to supply, on the subject of the scheme of defence adopted by the French Government, clear and precise ideas

in lieu of the vague and confused notions generally held on the matter by the French nation. The work deals fully with the subject, and is a valuable contribution to strategical geography.

The British in India. By the late Lord Justice James. Edited by his daughter, Mary J. Salis Schwabe. London: Macmillan. 1882. Pp. 362. Size $8\frac{3}{4}'' \times 5\frac{3}{4}'' \times 1\frac{1}{8}''$. Weight under 1 lb. 14 ozs. Price 12*s.* 6*d.*

FROM the preface we learn that "This book is the historical portion of a work commenced, partly to dispel the general ignorance of the past history and of the present state of India, and partly to put forward certain views as to the best means of governing India, and of rendering the people more prosperous. It exhibits the view taken by an eminent lawyer of the romantic incidents and startling vicissitudes that have chequered the existence of our Indian Empire." It is thoroughly readable and has been very favourably reviewed.

England on the Defensive; or, the Problem of Invasion critically examined under the aspect of a series of Military Operations, with special reference to the character of the Country and of the national Forces. By Captain J. T. Barrington. London: Kegan Paul Trench and Co. 1881. Pp. 328. Size $8'' \times 6'' \times 1\frac{1}{2}''$. Weight under 1 lb. 10 ozs. Price 7*s.* 6*d.*

THIS book should have been noticed ere this in the Journal. It is a valuable contribution to the consideration of a question which, were it not for the existence in the nation at large of an insane belief in the impassability of the "Silver Streak," would have been definitively solved long since: "The best defence of England against invasion."

Correspondence with Reference to the proposed Construction of a Channel Tunnel. Presented to both Houses of Parliament by command of Her Majesty, 1882. London: Printed at the War Office by Harrison and Sons. 1882. Pp. 368. Size $13'' \times 8\frac{1}{4}'' \times 1''$. Weight under $2\frac{1}{2}$ lbs. Price 4*s.*

THIS is one of the few Blue Books published which possess a personal interest for all Englishmen alike. It contains not merely correspondence, but also the Minutes of Evidence given before Captain Tyler's Commission, Mr. Farrer's Committee, and Sir A. Alison's Committee, the Report of the latter Committee, and also the important memoranda on the subject furnished by H.R.H. the Field Marshal Commanding-in-Chief, General Lord Wolseley, and Lieutenant-General Sir J. Adye.

Les Méthodes de Guerre; Actuelles et vers la Fin du XIXme Siècle. Par le Colonel Pierron. Paris: Baudoin et Cie. 1881. Tome III. 1re Partie. Pp. 695. Size $7\frac{1}{2}'' \times 5'' \times 1\frac{1}{2}''$. 2me Partie. Pp. 424. Size $7\frac{1}{2}'' \times 5'' \times 1''$. Weight of the volume $2\frac{1}{4}$ lbs. Price of the volume 10 francs.

A FULL account and review of the first two volumes of this valuable work appeared in No. XCIX of this Journal. The first part of the third volume deals with Outposts, Cantonments, and Camps; whilst the second part, nominally devoted to Investments, includes under that heading the attack and defence of works, defence of woods, villages, &c., telegraphic communication, behaviour towards inhabitants, and various other matters. It is to be hoped that ere long the author will give us a volume on tactics, pure and simple, which, judged by its predecessors, will most probably be of great value.